

FIG. 1

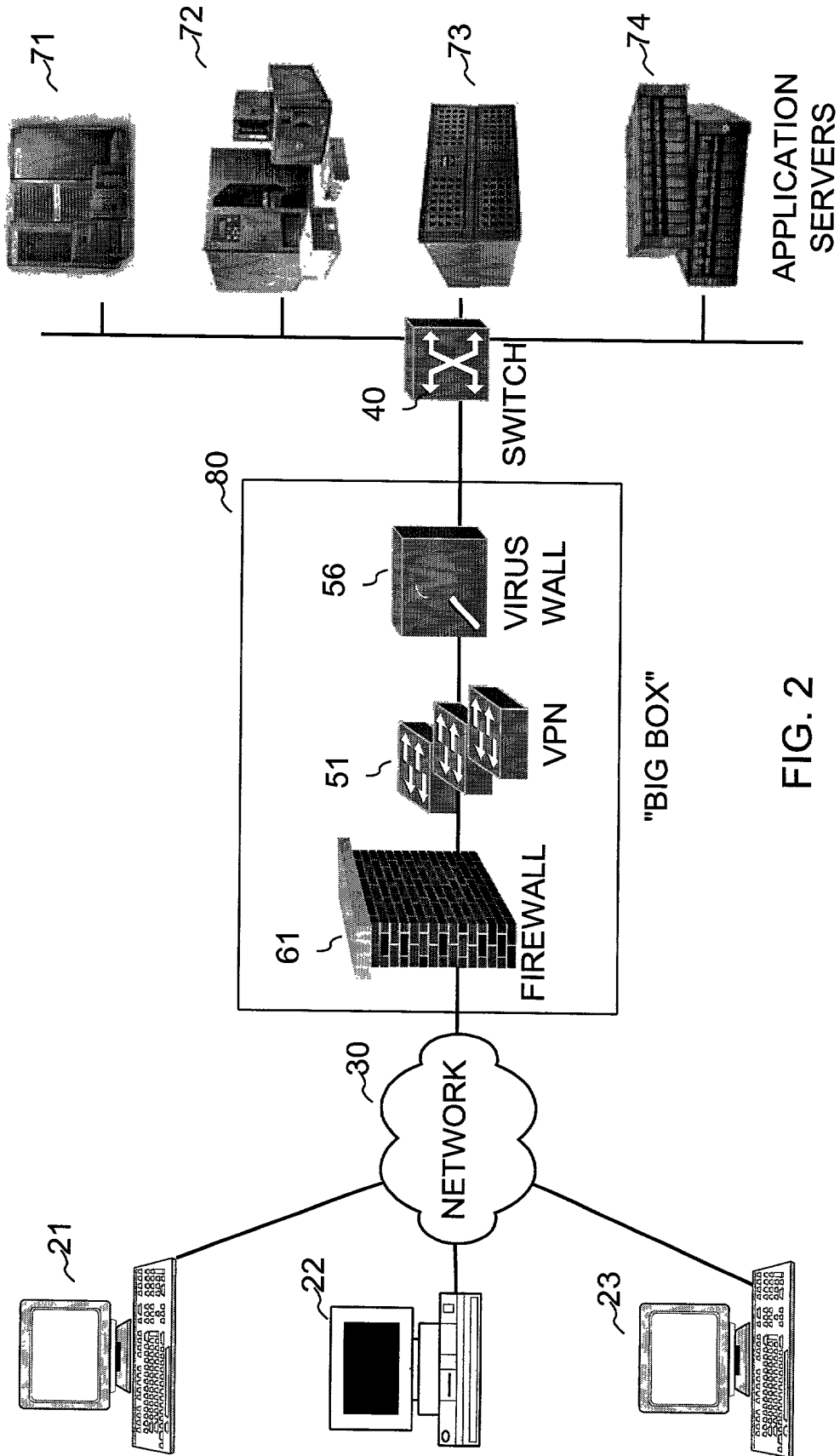


FIG. 2

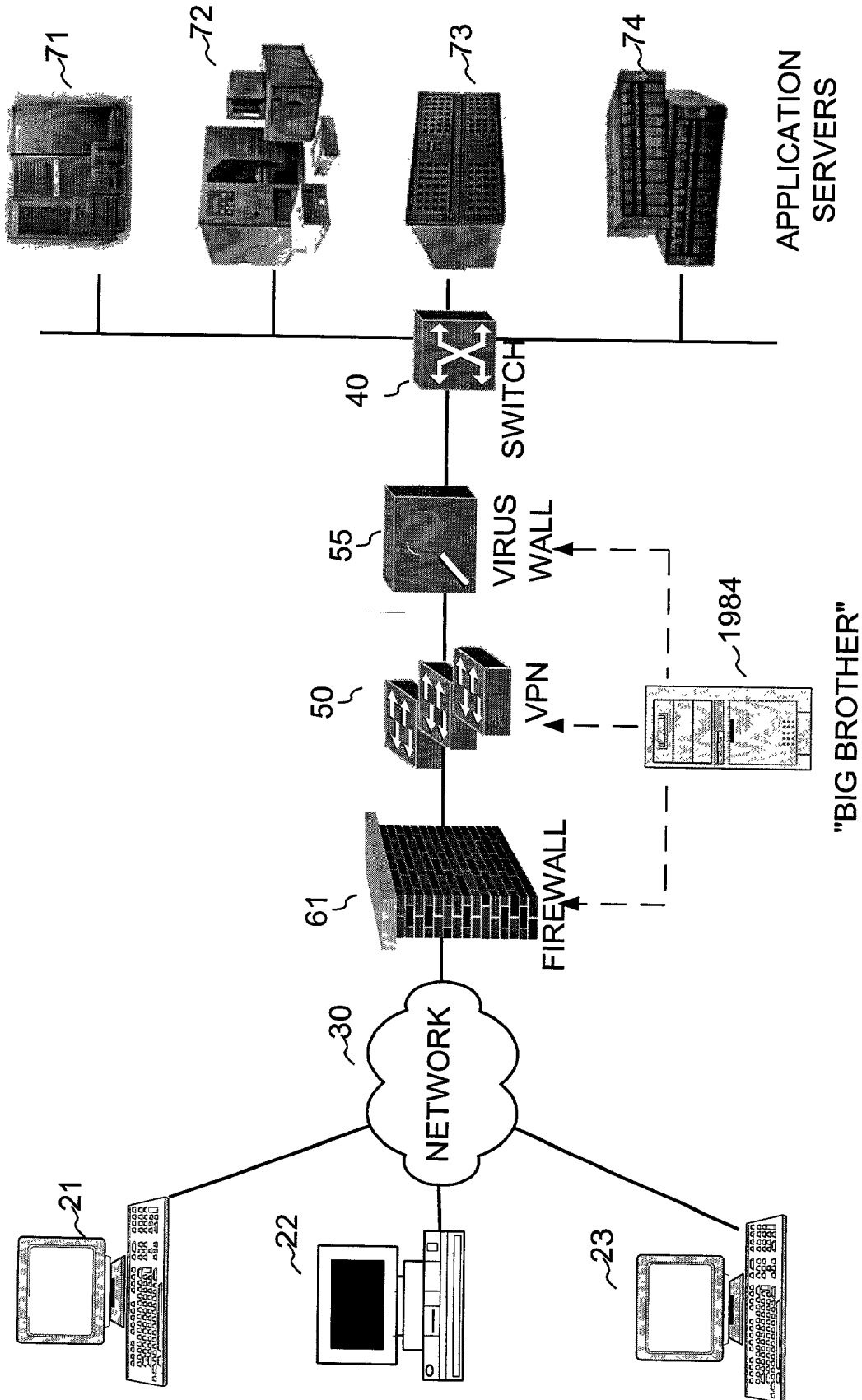


FIG. 3

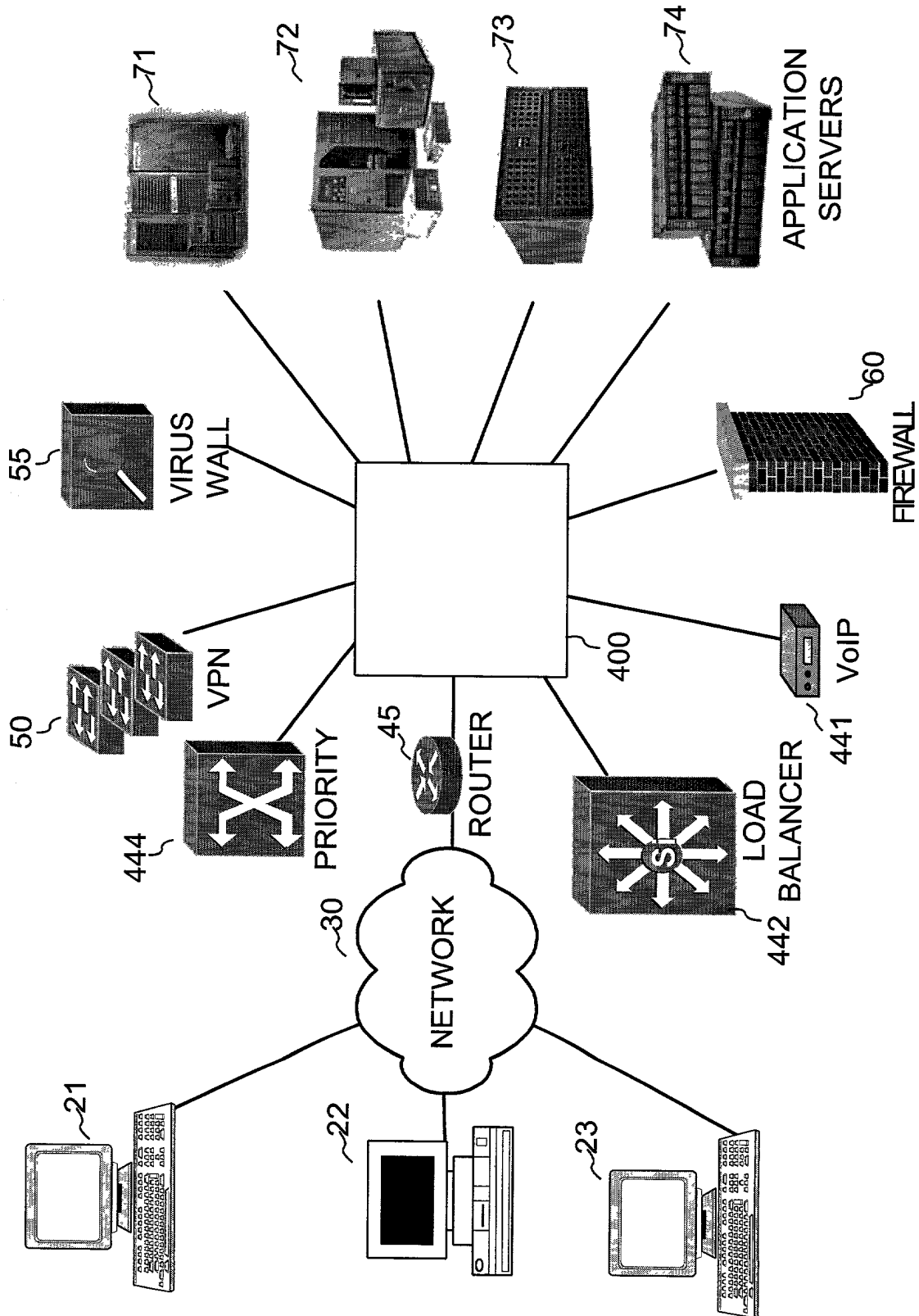


FIG. 4

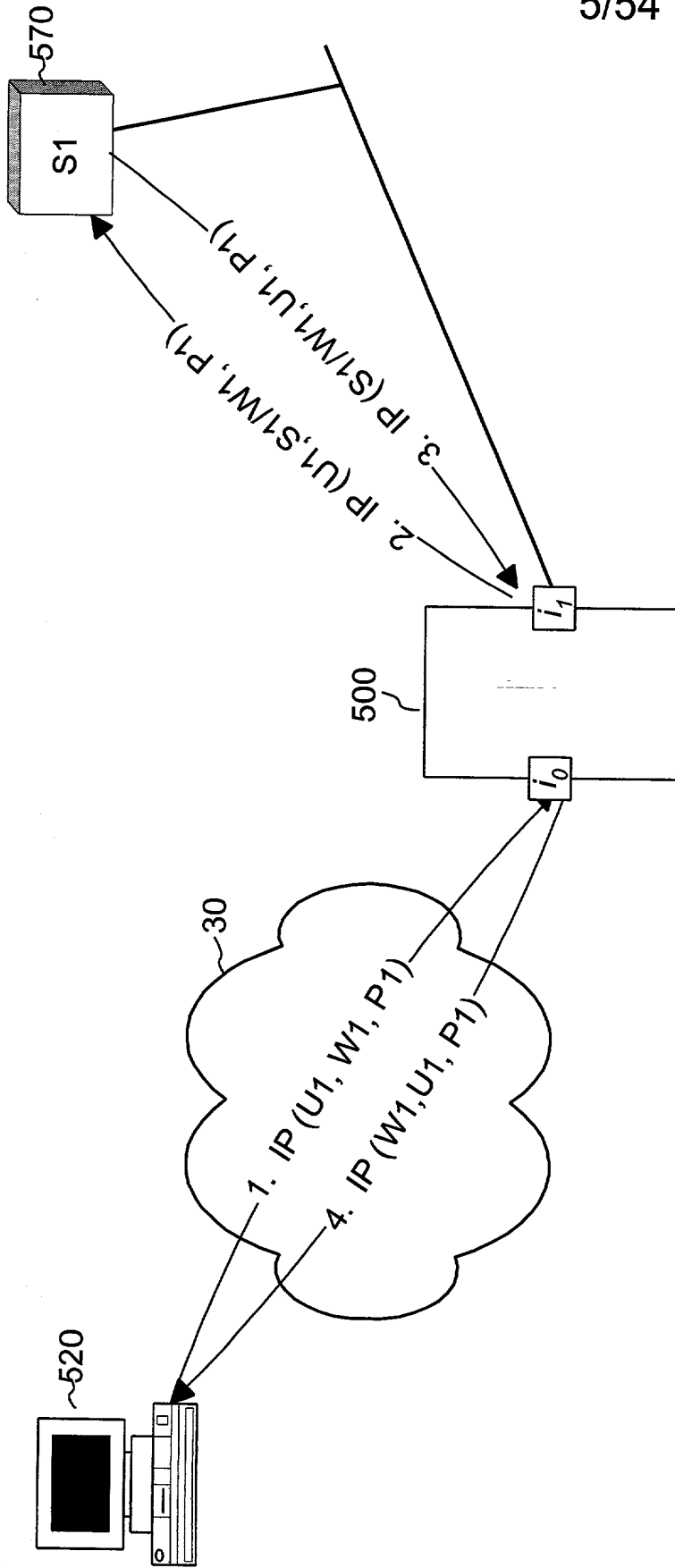


FIG. 5

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1 (SERVER)	U1	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	P1
3	S1	PACKETING ENGINE	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

FIG. 5A

531

533

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	W1	P1
3	S1	PACKETING ENGINE	W1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

FIG. 5C

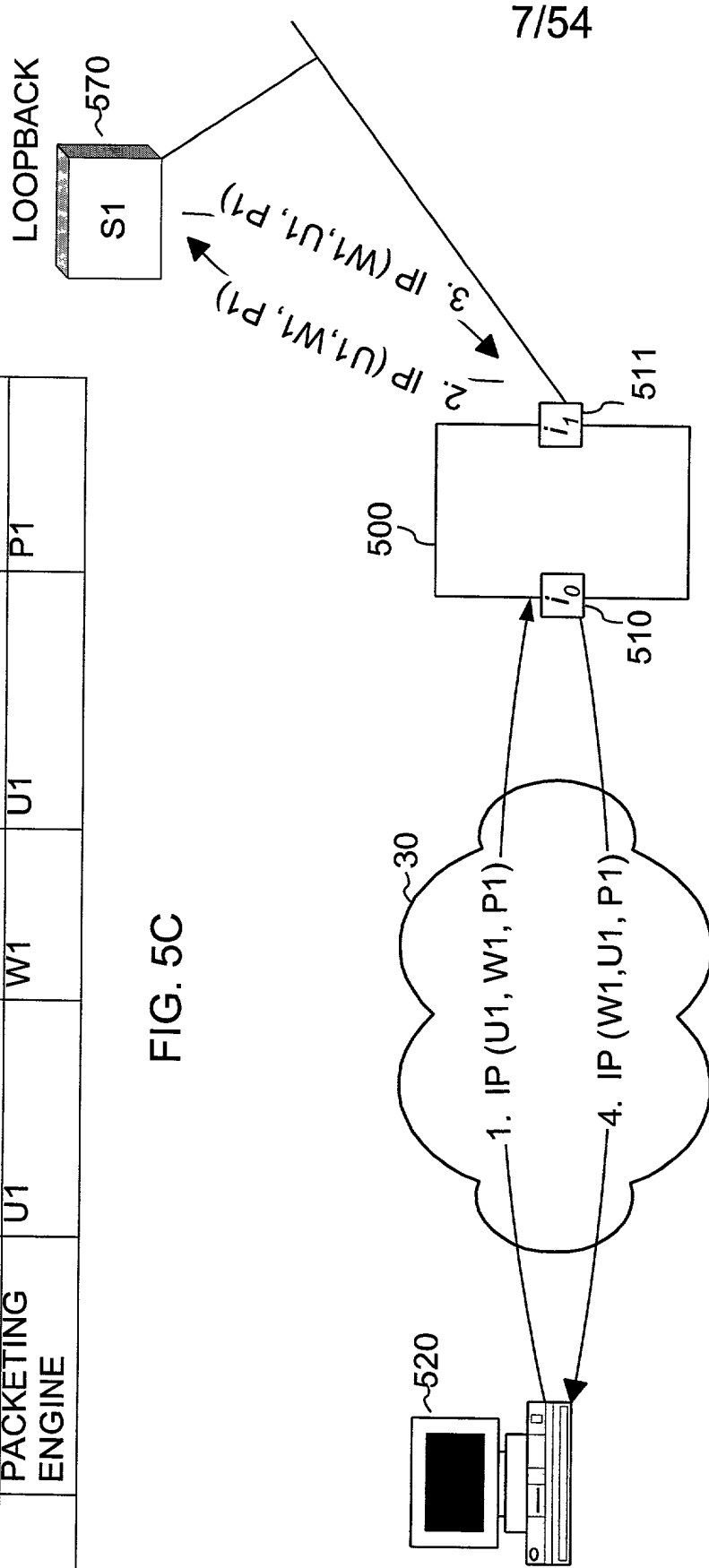


FIG. 5B

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	W1	P1
3	S1	PACKETING ENGINE	W1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

536

FIG. 5F

TABLE MAINTAINED BY PACKETING ENGINE						
RECEIVE PACKET INBOUND TO PACKETING ENGINE			SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE ADDRESS		DESTINATION IP ADDRESS	SERVICE PORT	SEND VIA INT.	SEND PACKET TO
	MAC	IP				MAC IP
I ₀			W1	P1	I ₁	S _{1M} W1
I ₁	S _{1M}	W1		P1	I ₀	ROUTER DEFAULT ROUTE

537

538

FIG. 5G

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	S1	P1
3	S1	PACKETING ENGINE	S1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

539

FIG. 5I

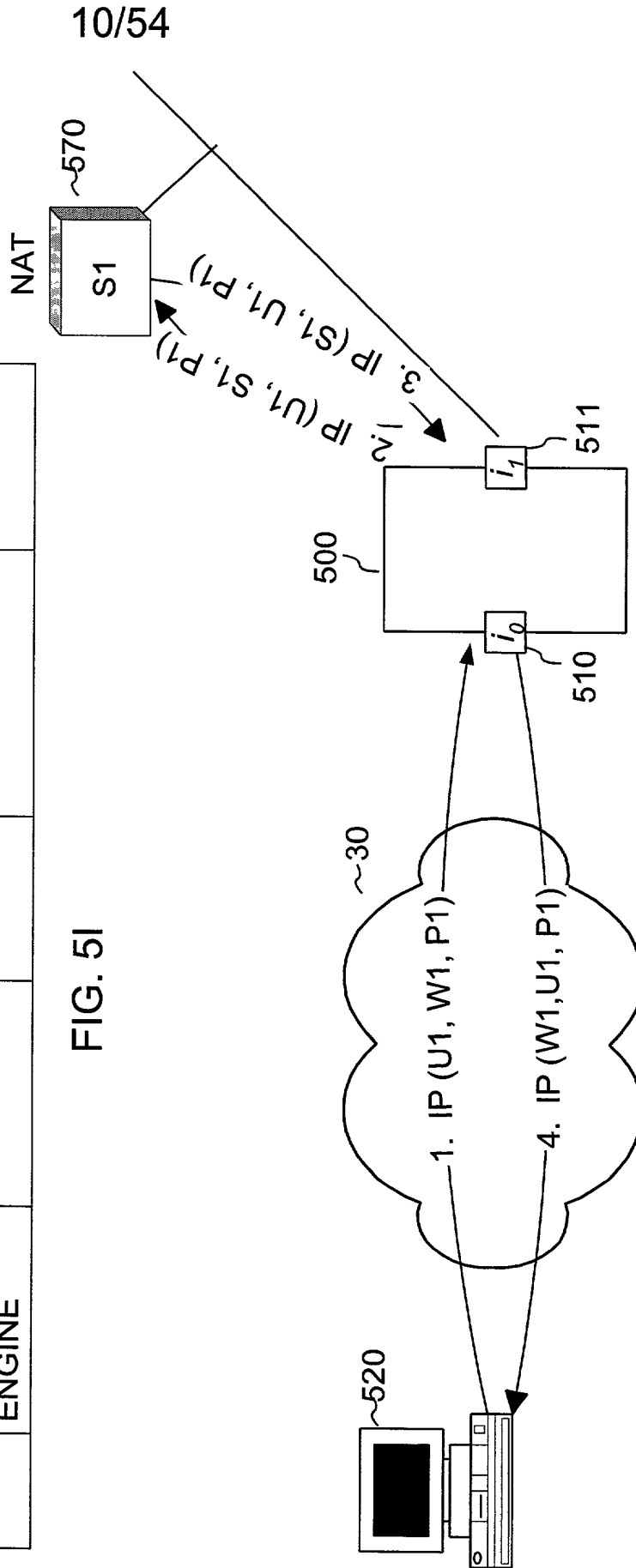


FIG. 5H

TABLE MAINTAINED BY PACKETING ENGINE					
RECEIVE PACKET INBOUND TO PACKETING ENGINE			SEND IT OUTBOUND FROM PACKETING ENGINE		
RCX ON INT.	SOURCE IP ADDRESS	DESTINATION IP ADDRESS	SERVICE PORT	SEND VIA INT.	SEND PACKET TO IP ADDRESS
I ₀	S1	W1	P1	I ₁	S1
I ₁			P1	I ₀ (AFTER REVERSE NAT SOURCE IP TO W1)	DEFAULT ROUTE

FIG. 5J

11/54

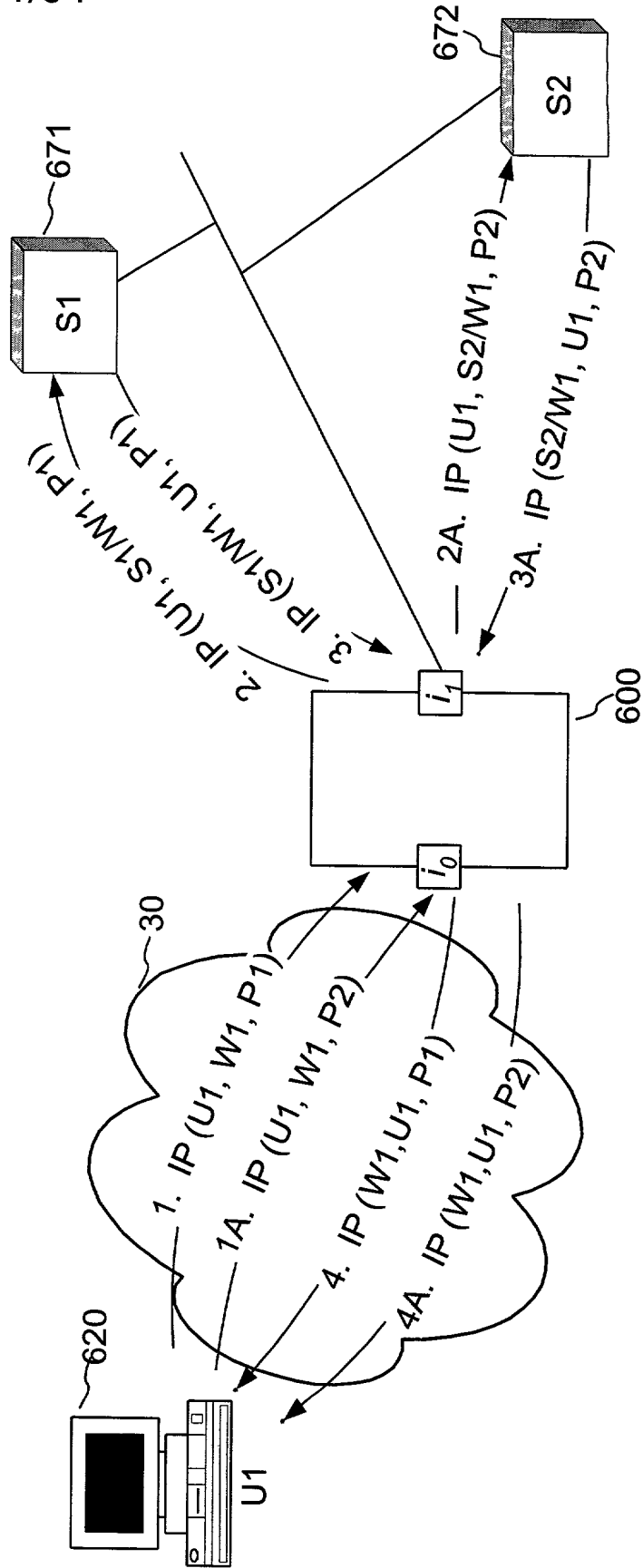


FIG. 6

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
PORT P1					
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1 (SERVER)	U1	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	P1
3	S1	PACKETING ENGINE	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1
PORT P2					
1A	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P2
2A	PACKETING ENGINE	S2 (SERVER)	U1	S2 (IF NAT IS REQUIRED); W1 (IF S2 SUPPORTS LOOPBACK OR ALIAS)	P2
3A	S1	PACKETING ENGINE	S2 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P2
4A	PACKETING ENGINE	U1	W1	U1	P2

FIG. 6A

TABLE MAINTAINED BY PACKETING ENGINE							
RECEIVE PACKET INBOUND TO PACKETING ENGINE				SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE IP ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO
	MAC	IP					
I ₀			W1	P1	I ₁	LOOPBACK	S1 _M W1
I ₁	S1 _M	W1		P1	I ₀ (AFTER REVERSE NAT SOURCE IP TO W1)	ROUTER	S1 _M W1
	S1 _M	S1					S1 S1
I ₀			W1	P2	I ₁	LOOPBACK	S2 _M W1
I ₁	S2 _M	W1		P2	I ₀ (AFTER REVERSE NAT SOURCE IP TO W1)	ROUTER	S2 _M W1
	S2 _M	S2					S2 S2
							DEFAULT ROUTE

FIG. 6B

632

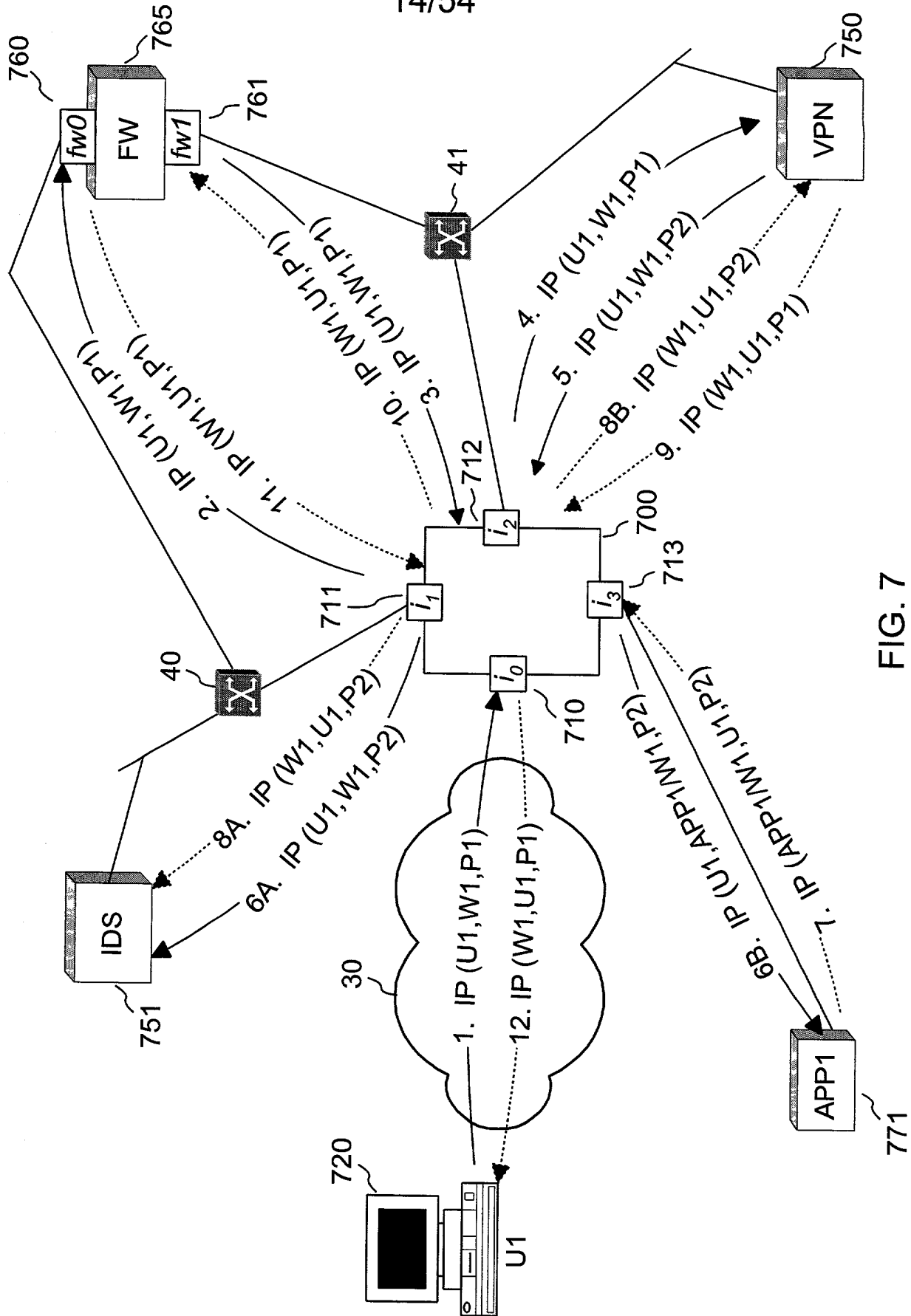


FIG. 7

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FW (INTERFACE FW0)	U1	W1	P1
3	FW (INTERFACE FW1)	PACKETING ENGINE	U1	W1	P1
4	PACKETING ENGINE	VPN	U1	W1	P1
5	VPN	PACKETING ENGINE	U1	W1	P2
6A	PACKETING ENGINE	IDS	U1	W1	P2
6B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	P2
7	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	P2
8A	PACKETING ENGINE	IDS	W1	U1	P2
8B	PACKETING ENGINE	VPN	W1	U1	P2
9	VPN	PACKETING ENGINE	W1	U1	P1
10	PACKETING ENGINE	FW (INTERFACE FW1)	W1	U1	P1
11	FW (INTERFACE FW0)	PACKETING ENGINE	W1	U1	P1
12	PACKETING ENGINE	U1	W1	U1	P1

FIG. 7A

TABLE MAINTAINED BY PACKETING ENGINE									
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE				
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO		
	MAC	IP					MAC	IP	
I ₀			W1	P1	I ₁	TRANSPARENT	FW0 _M	W1	
I ₂	FW1 _M		W1	P1	I ₂	TRANSPARENT	VPN _M	W1	
I ₂	VPN _M		W1	P2	I ₁	TRANSPARENT	IDS _M	W1	
					I ₃	LOOPBACK	APP1 _M	W1	
						ALIAS	APP1 _M	W1	
						NAT		APP1	
I ₁	IDS _M			P2	I ₃	LOOPBACK	APP1 _M	W1	
						ALIAS	APP1 _M	W1	
						NAT		APP1	
I ₃	APP1 _M	APP1 OR W1		P2	I ₁	TRANSPARENT	IDS _M		
					I ₂	TRANSPARENT	VPN _M		
I ₂	VPN _M	W1		P1	I ₂	TRANSPARENT	FW1 _M		
I ₁	FW0 _M	W1		P1	I ₀	ROUTER			DEFAULT ROUTE

FIG. 7B

732

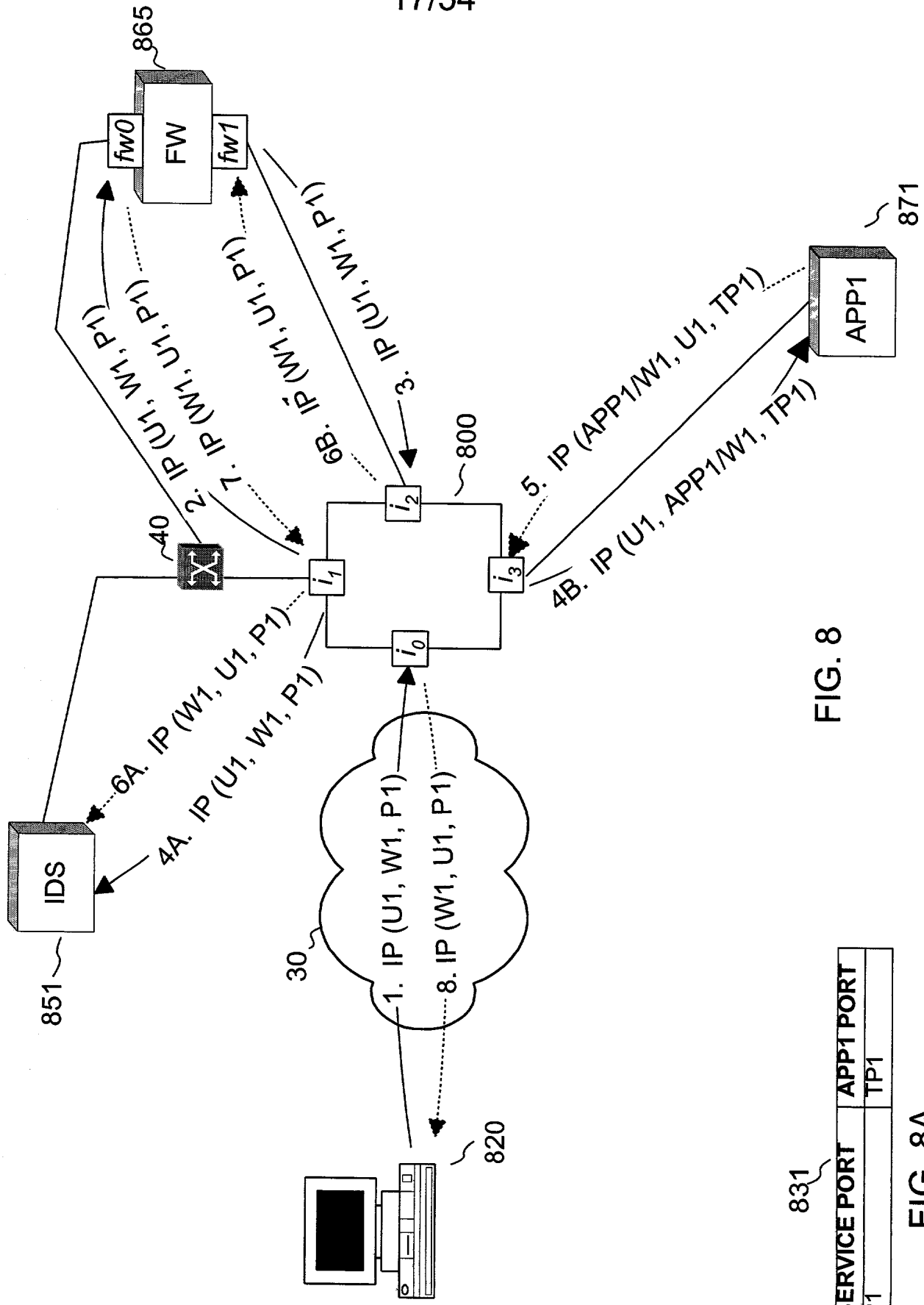


FIG. 8

831

SERVICE PORT	APP1 PORT
P1	TP1

FIG. 8A

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FW (INTERFACE FW0)	U1	W1	P1
3	FW (INTERFACE FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	TP1
5	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	TP1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	FW (INTERFACE FW1)	W1	U1	P1
7	FW (INTERFACE FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1

FIG. 8B

TABLE MAINTAINED BY PACKETING ENGINE									
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE				
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO		PORT
	MAC	IP					MAC	IP	
I ₀			W ₁	P ₁	I ₁	TRANSPARENT	FW _{0M}	W ₁	P ₁
I ₂	FW _M		W ₁	P ₁	I ₁	TRANSPARENT	IDS _M	W ₁	P ₁
					I ₃	LOOPBACK	APP _{1M}	W ₁	TP ₁
						ALIAS	APP _{1M}	W ₁	TP ₁
						NAT		APP ₁	TP ₁
I ₁	IDS _M			P ₁	I ₃	LOOPBACK	APP _{1M}	W ₁	TP ₁
						ALIAS	APP _{1M}	W ₁	TP ₁
						NAT		APP ₁	TP ₁
I ₃	APP _{1M}	APP ₁ OR W ₁		TP ₁	I ₁	TRANSPARENT	IDS _M		P ₁
					I ₂	TRANSPARENT	FW _{1M}		P ₁
I ₁	FW _M	W ₁		P ₁	I ₀	ROUTER		DEFAULT ROUTE	P ₁

FIG. 8C

833

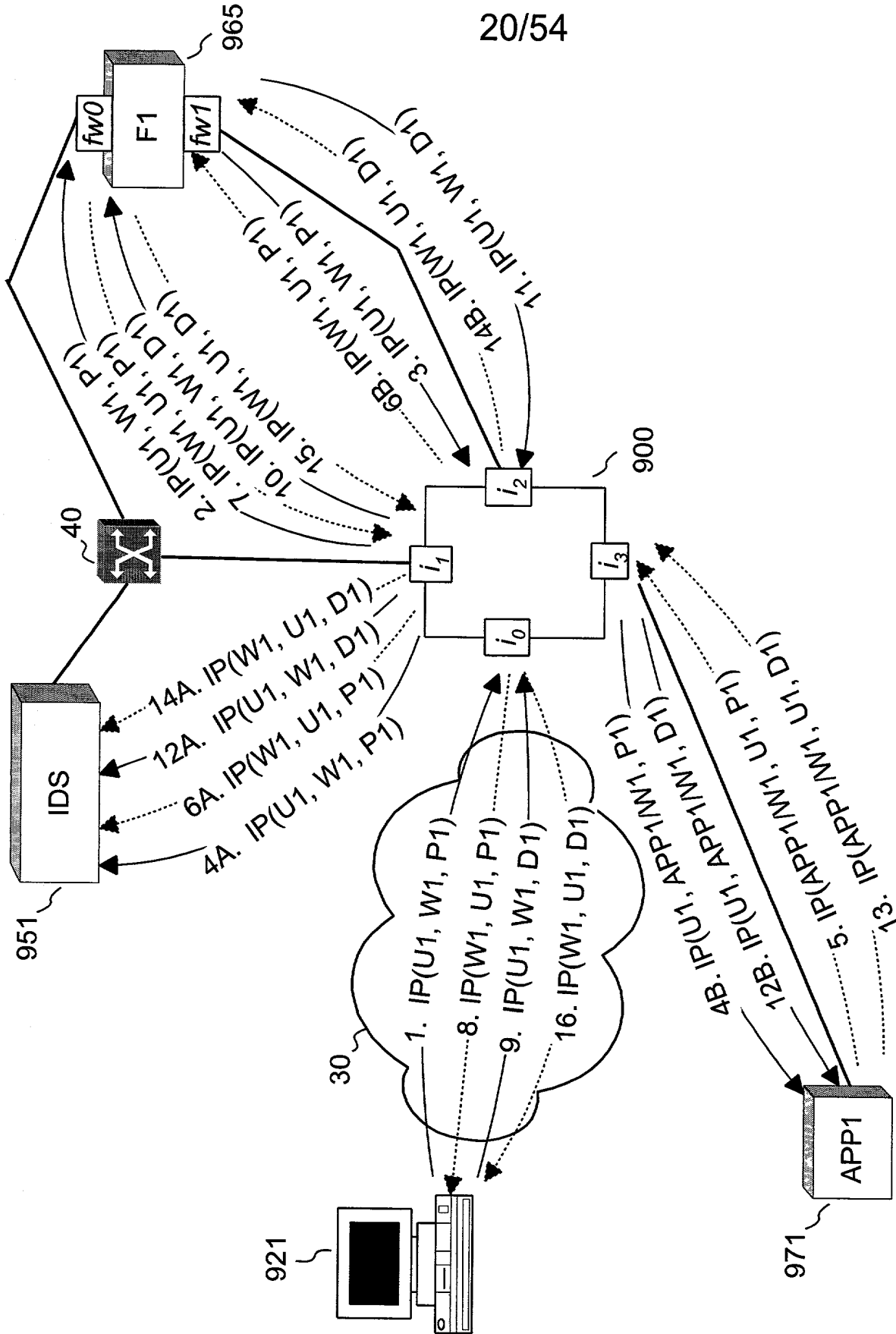


FIG. 9

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FIREWALL F1 (INT. FW0)	U1	W1	P1
3	FIREWALL F1 (INT. FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	P1
5	APP1	PACKETING ENGINE	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	U1	P1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	FIREWALL F1 (INT. FW1)	W1	U1	P1
7	FIREWALL F1 (INT. FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1
9	U1 (CLIENT)	PACKETING ENGINE	U1	W1	D1
10	PACKETING ENGINE	FIREWALL F1 (INT. FW0)	U1	W1	D1
11	FIREWALL F1 (INT. FW1)	PACKETING ENGINE	U1	W1	D1
12A	PACKETING ENGINE	IDS	U1	W1	D1
12B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	D1
13	APP1	PACKETING ENGINE	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	U1	D1
14A	PACKETING ENGINE	IDS	W1	U1	D1
14B	PACKETING ENGINE	FIREWALL F1 (INT. FW1)	W1	U1	D1
15	FIREWALL F1 (INT. FW0)	PACKETING ENGINE	W1	U1	D1
16	PACKETING ENGINE	U1	W1	U1	D1

FIG. 9A

TABLES MAINTAINED BY PACKETING ENGINE									
RECEIVE PACKET INBOUND TO PACKETING ENGINE				SEND IT OUTBOUND FROM PACKETING ENGINE					
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO		
	MAC	IP					MAC	IP	
I ₀			W1	P1 OR PORT IN RANGE OF 1025→1125	I ₁	TRANSPARENT	FW0 _M		W1
I ₂	FW1 _M		W1	P1 OR PORT IN RANGE OF 1025→1125	I ₁	TRANSPARENT	IDS _M		W1
					I ₃	LOOPBACK	APP1 _M		W1
						ALIAS	APP1 _M		W1
						NAT		APP1	APP1
I ₁	IDS _M			P1 OR PORT IN RANGE OF 1025→1125	I ₃	LOOPBACK	APP1		W1
						ALIAS	APP1 _M		W1
						NAT			APP1
I ₃	APP1 _M	APP1 OR W1		P1 OR PORT IN RANGE OF 1025→1125	I ₁	TRANSPARENT	IDS _M		
					I ₂	TRANSPARENT	FW1 _M		
I ₁	FW2 _M	W1		P1 OR PORT IN RANGE OF 1025→1125	I ₀	ROUTER			DEFAULT ROUTE

FIG. 9B

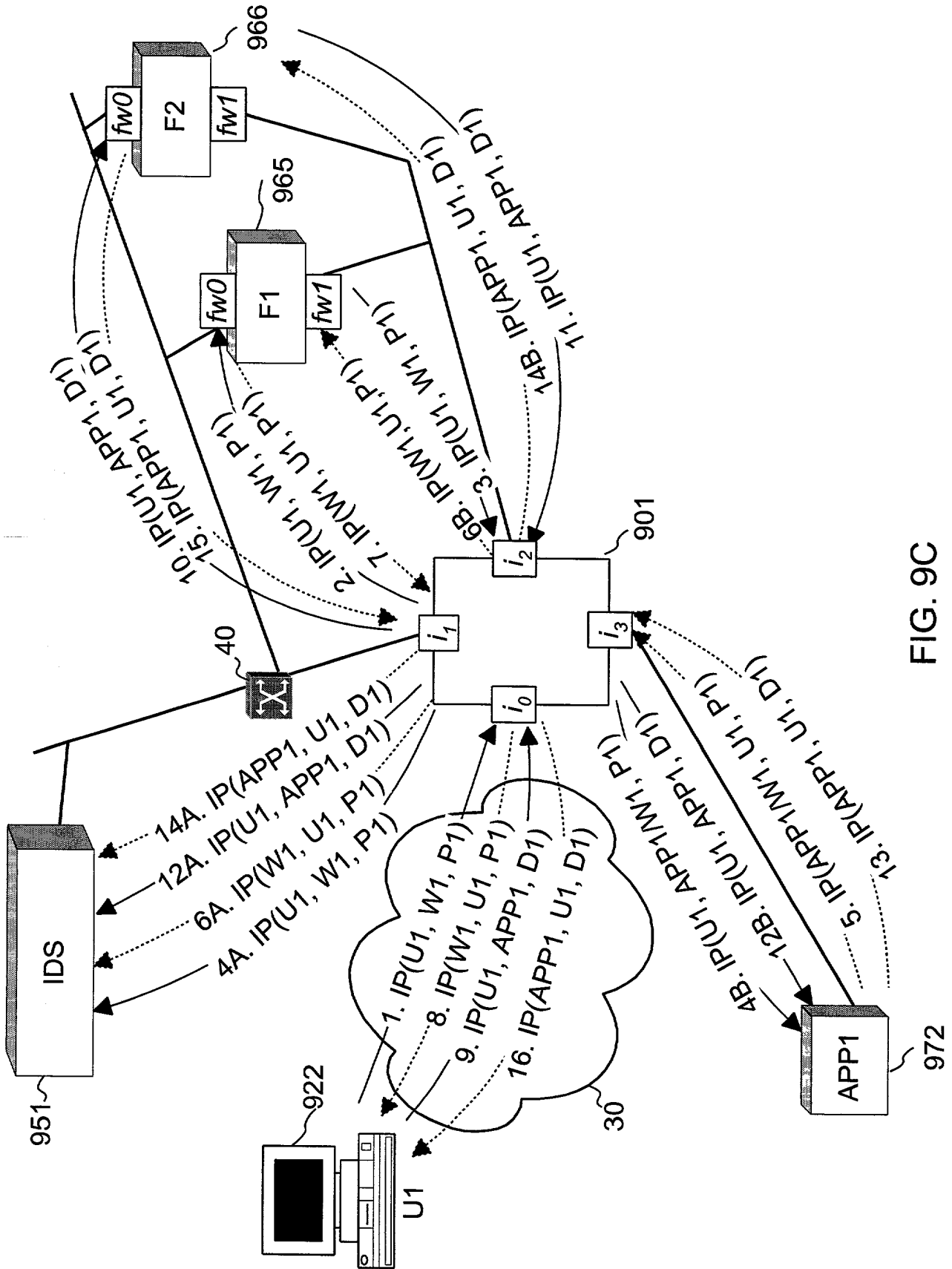


FIG. 9C

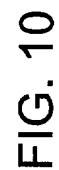
STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	F1 (INT. FW0)	U1	W1	P1
3	F1 (INT. FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	P1
5	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	P1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	F1 (INT. FW1)	W1	U1	P1
7	F1 (INT. FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1
9	U1 (CLIENT)	PACKETING ENGINE	U1	APP1	D1
10	PACKETING ENGINE	F2 (INT. FW0)	U1	APP1	D1
11	F2 (INT. FW1)	PACKETING ENGINE	U1	APP1	D1
12A	PACKETING ENGINE	IDS	U1	APP1	D1
12B	PACKETING ENGINE	APP1	U1	APP1	D1
13	APP1	PACKETING ENGINE	APP1	U1	D1
14A	PACKETING ENGINE	IDS	APP1	U1	D1
14B	PACKETING ENGINE	F2 (INT. FW1)	APP1	U1	D1
15	F2 (INT. FW0)	PACKETING ENGINE	APP1	U1	D1
16	PACKETING ENGINE	U1	APP1	U1	D1

934

FIG. 9D

TABLES MAINTAINED BY PACKETING ENGINE									
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE				
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO		
	MAC	IP					MAC	IP	
I ₀			W1	P1	I ₁	TRANSPARENT	F1(FW0) _M	W1	
I ₂	F1(FW1) _M		W1	P1	I ₁	TRANSPARENT	IDS _M	W1	
					I ₃	LOOPBACK	APP1 _M	W1	
						ALIAS	APP1 _M	W1	
						NAT		APP1	
I ₁	IDS _M			P1	I ₃	LOOPBACK	APP1 _M	W1	
						ALIAS	APP1 _M	W1	
						NAT		APP1	
I ₃	APP1 _M	APP1 OR W1		P1	I ₁	TRANSPARENT	IDS _M		
					I ₂	TRANSPARENT	F1(FW1) _M		
I ₁	F1(FW0) _M	W1		P1	I ₀	ROUTER		DEFAULT ROUTE	
I ₀			APP1	PORT>1024	I ₁	TRANSPARENT	F2(FW0) _M	APP1	
I ₂	F2(FW1) _M		APP1	PORT>1024	I ₁	TRANSPARENT	IDS _M	APP1	
					I ₃	SERVER IP ADDRESS	APP1 _M	APP1	
I ₁	IDS _M			PORT>1024	I ₃	SERVER IP ADDRESS	APP1 _M	APP1	
I ₃	APP1 _M	APP1		PORT>1024	I ₁	TRANSPARENT	IDS _M		
					I ₂	TRANSPARENT	F2(FW1) _M		
I ₁	F2(FW0) _M	APP1		PORT>1024	I ₀	ROUTER		DEFAULT ROUTE	

FIG. 9E



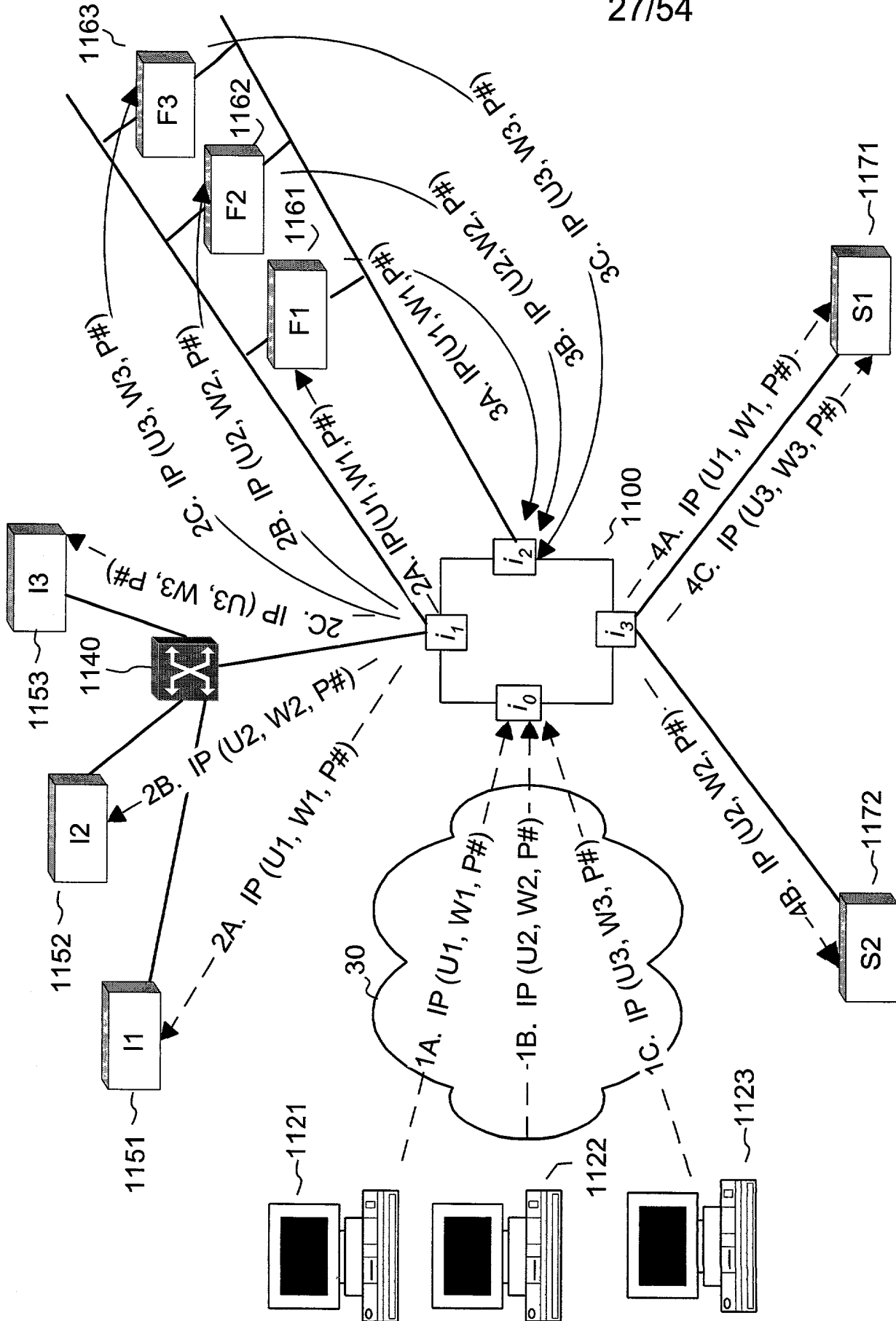


FIG. 11

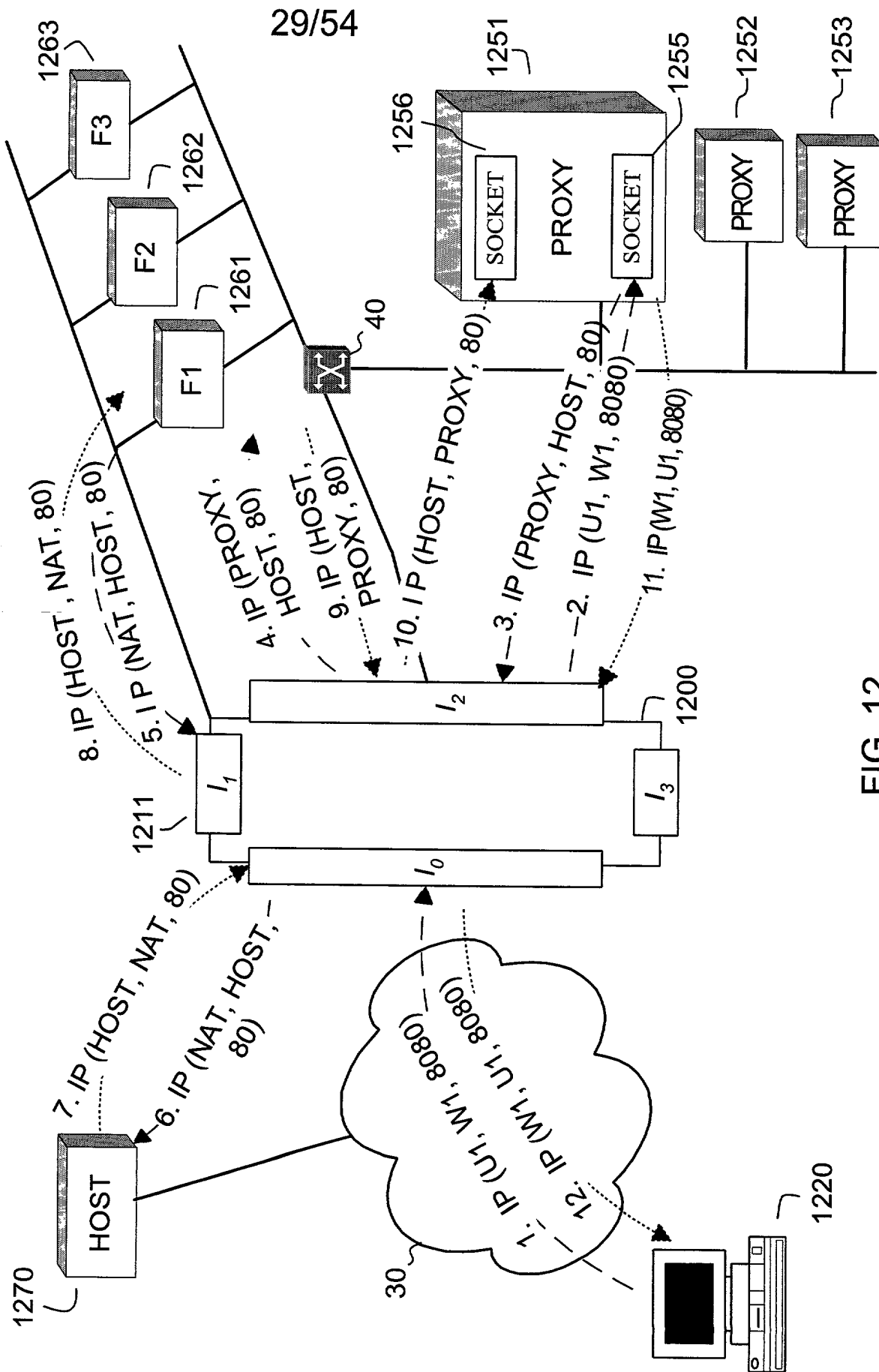


FIG. 12

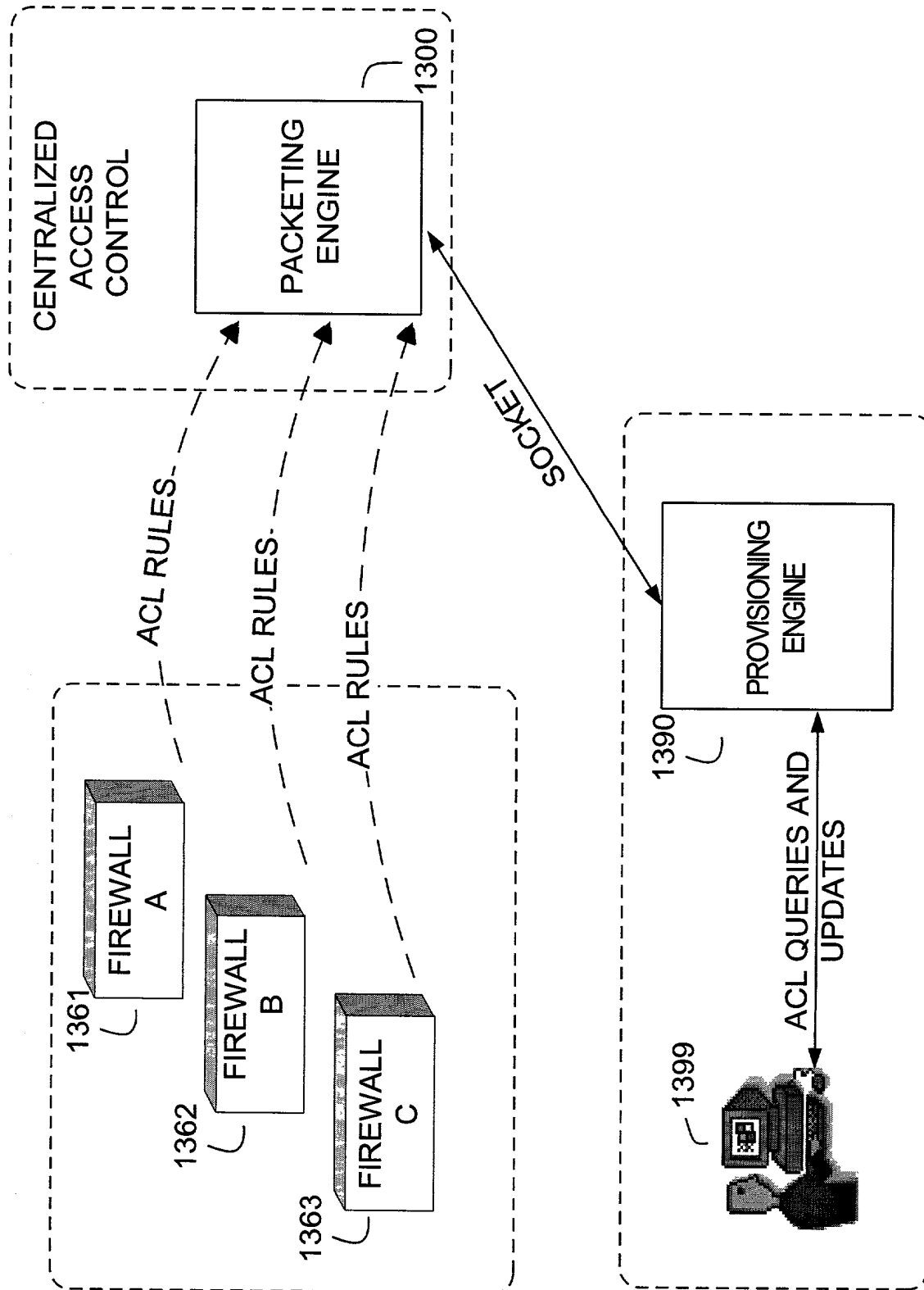


FIG. 13

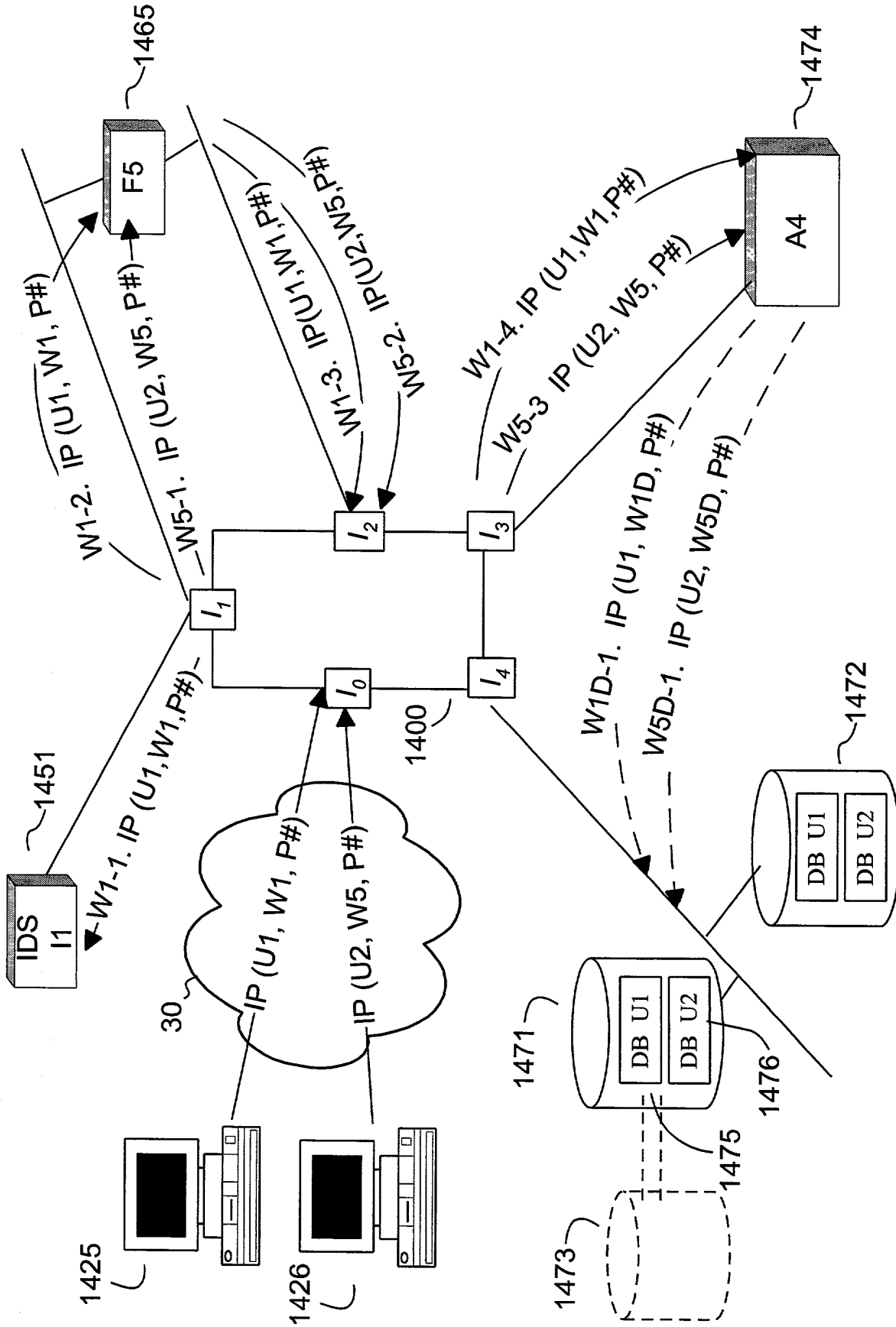


FIG. 14

SERVICE IP ADDRESS W1

STEP W1-1	INTRUSION DETECTION	I1
STEP W1-2/3	FIREWALL	F5
STEP W1-4	APPLICATION SERVER	A4

FIG. 14A

FIG. 14B

SERVICE IP ADDRESS W5

STEP W5-1/2	FIREWALL	F5
STEP W5-3	APPLICATION SERVER	A4

SERVICE IP ADDRESS W5D

STEP W5D-1	DATABASE SERVER	D1
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FIG. 14D

SERVICE IP ADDRESS W1D

STEP W1D-1	DATABASE SERVER	D1
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FIG. 14C

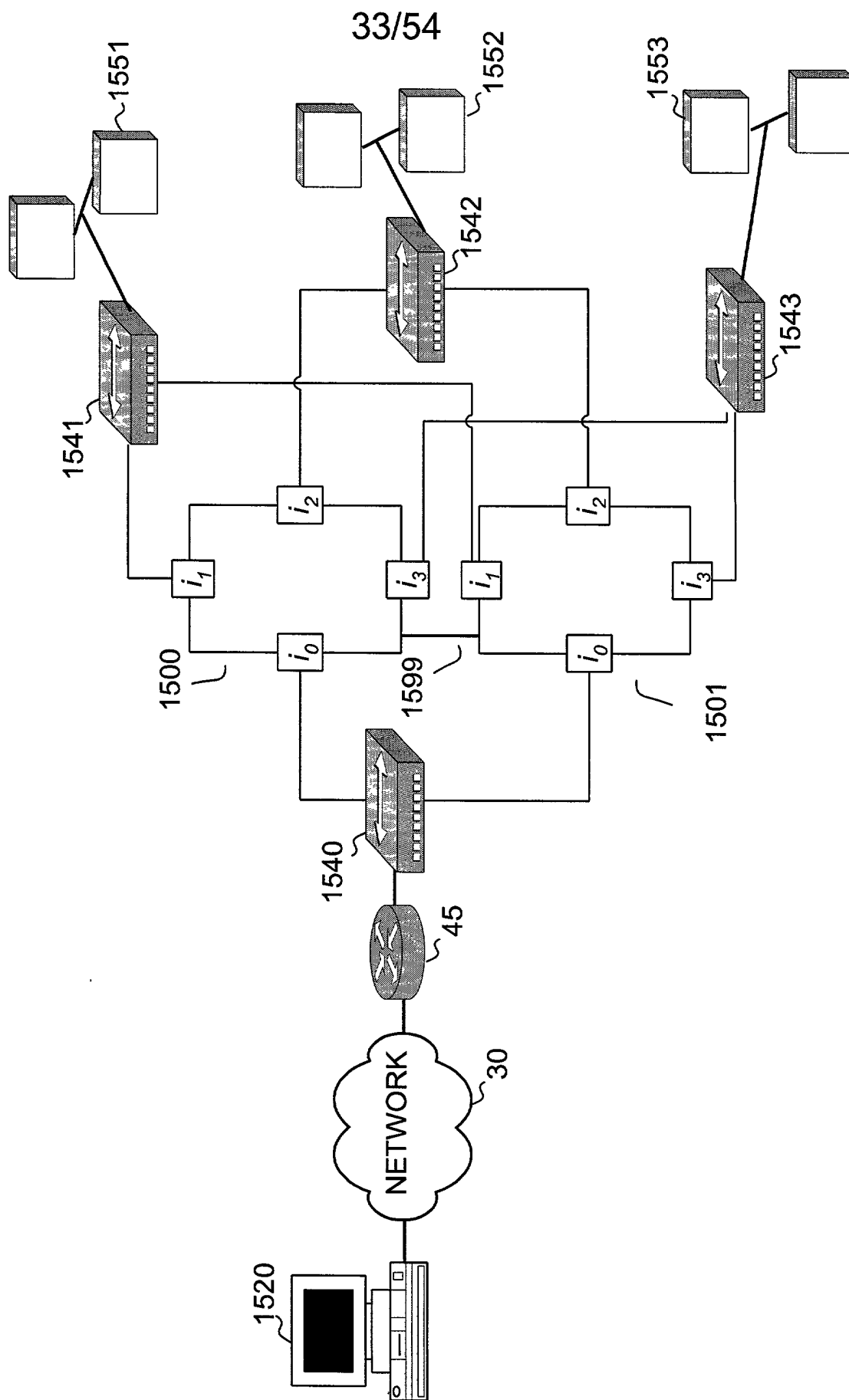


FIG. 15

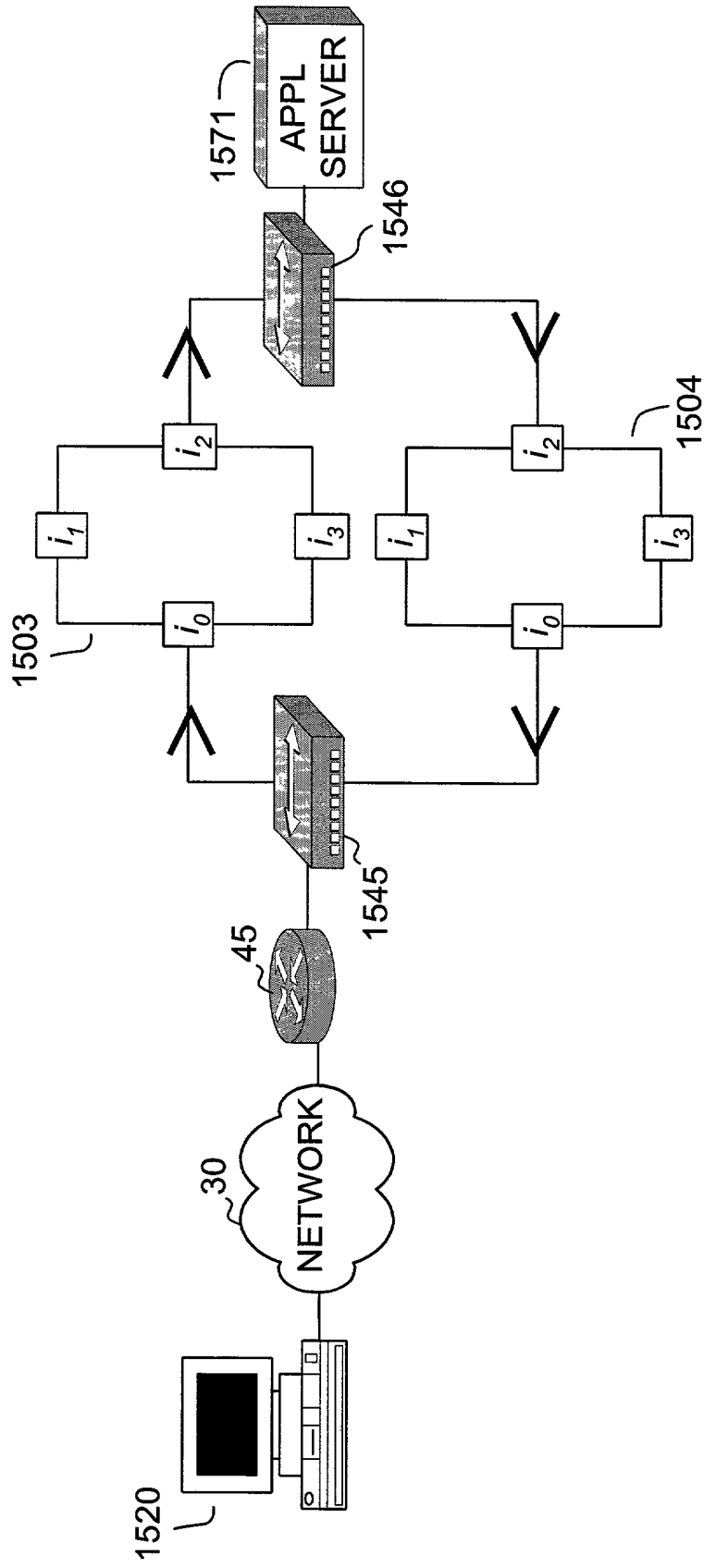


FIG. 15A

FIG. 15B is a schematic diagram of a network architecture. A central switch 40 is connected to a bus 1505. The bus 1505 is connected to three interfaces: i_1 , i_0 , and i_3 . Interface i_1 is connected to a group of three firewalls: F1 (1561), F2 (1562), and F3 (1563). Interface i_0 is connected to a group of two firewalls: F1 (1561) and F2 (1562). Interface i_3 is connected to a group of two firewalls: F1 (1561) and F2 (1562).

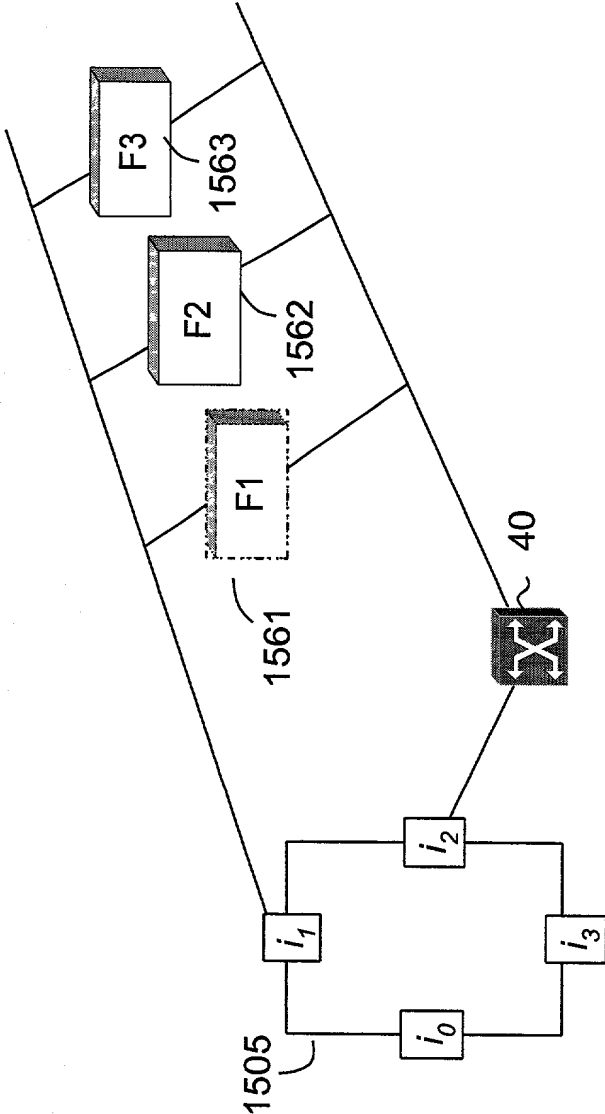


FIG. 15B

1533

SEND IT OUTBOUND FROM PACKETING ENGINE			
SEND FROM INTERFACE	DEST. SYSTEM TYPE	SEND PACKET TO	
		MAC	IP
i_1	TRANSPARENT	FIREWALL F1 _M	W1
i_1	TRANSPARENT	FIREWALL F2 _M	W1

FIG. 15C

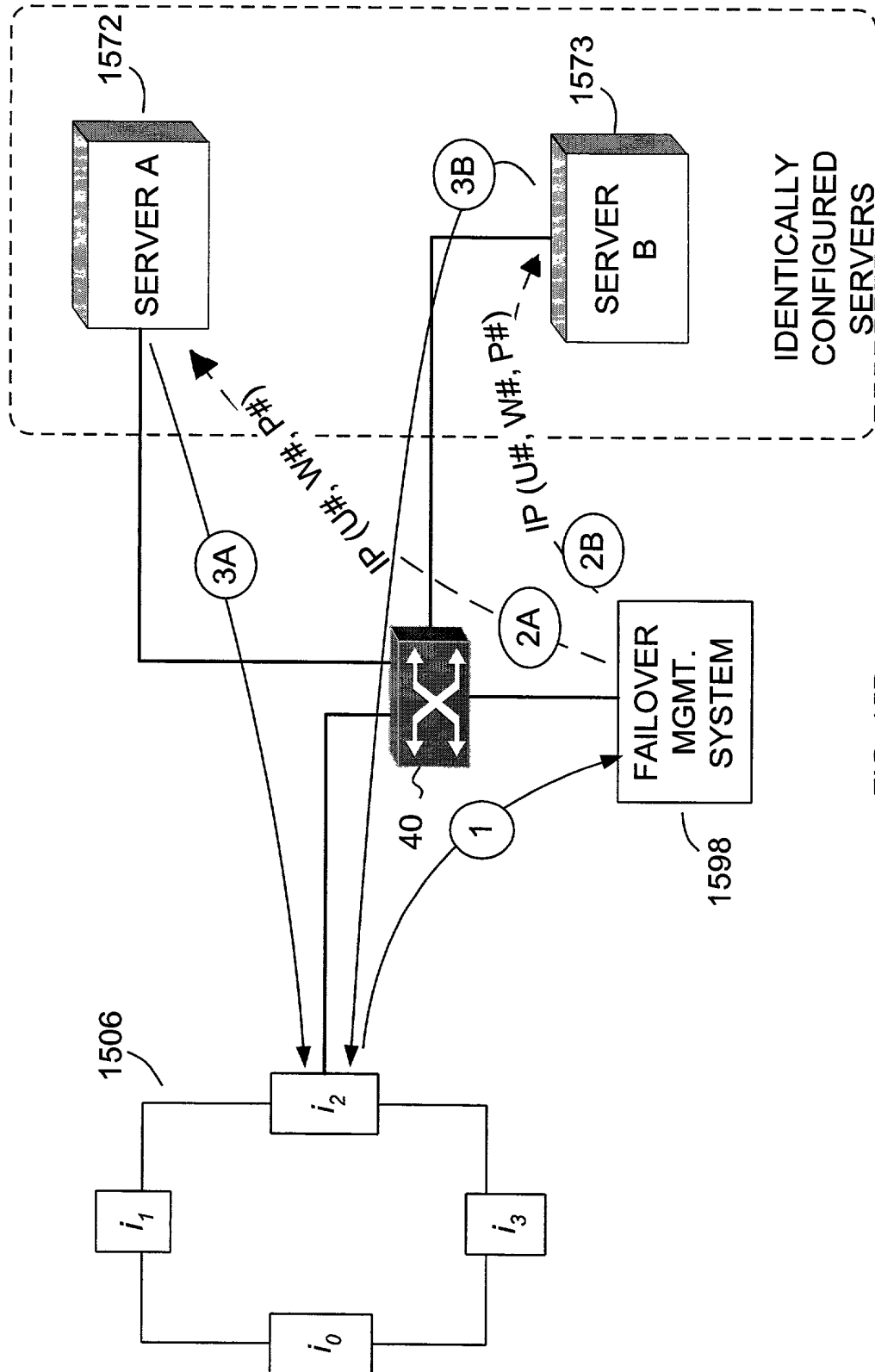


FIG. 15D

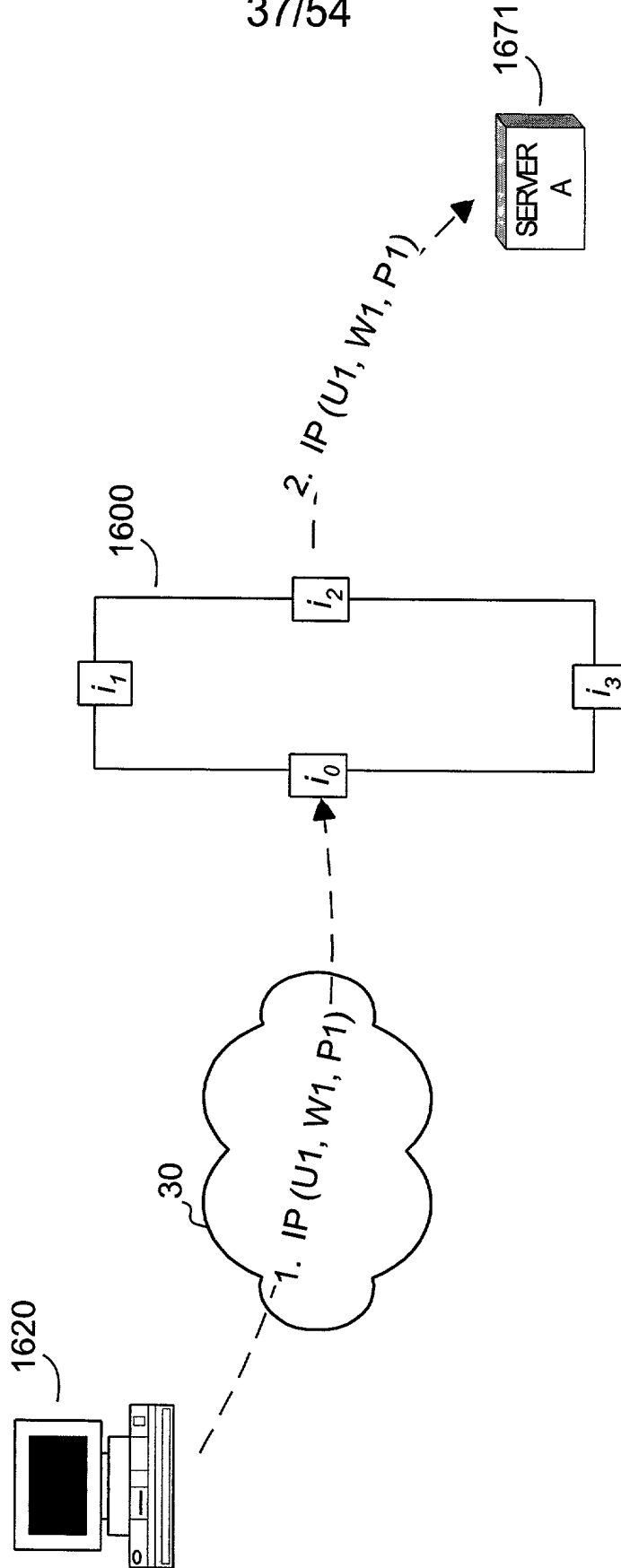


FIG. 16

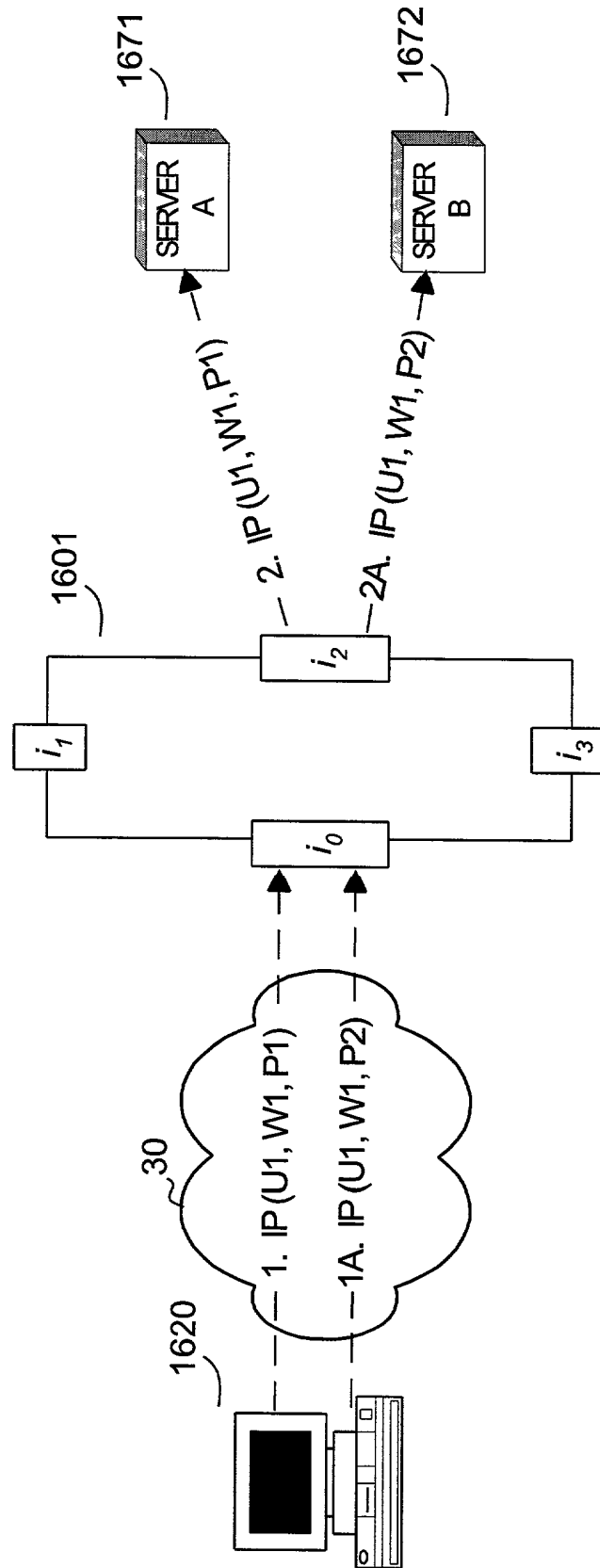


FIG. 16A

39/54

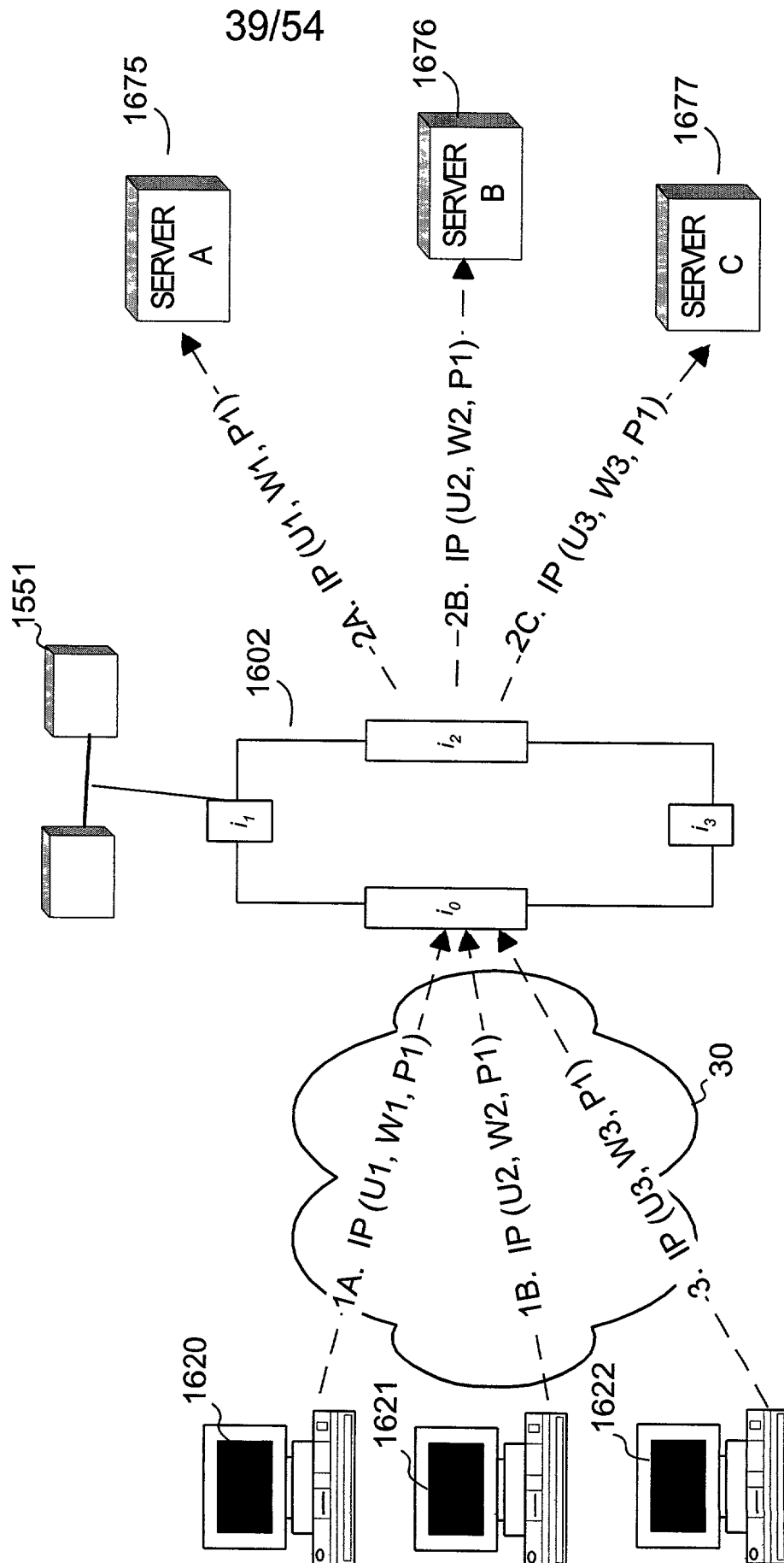


FIG. 16B

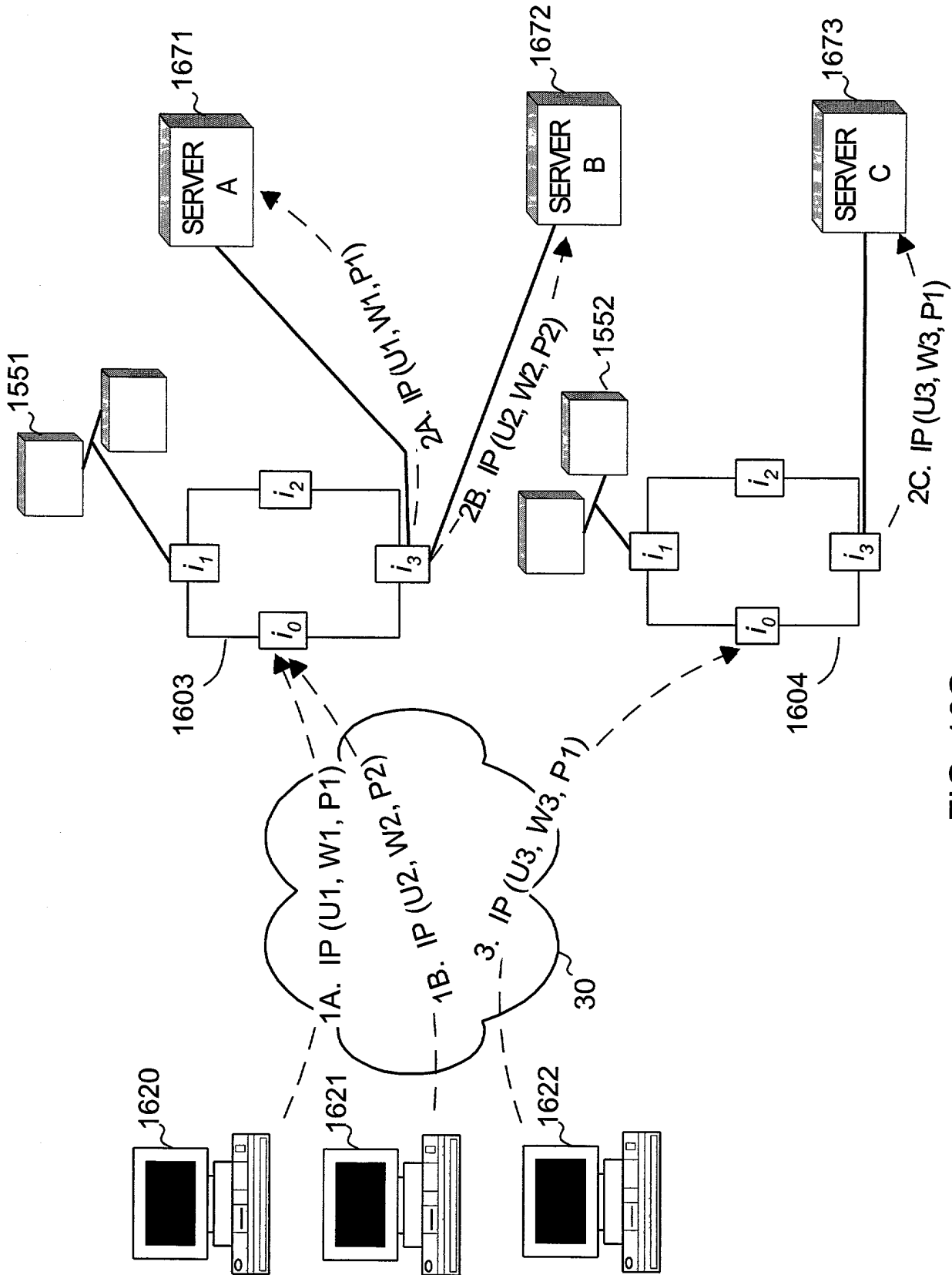


FIG. 16C

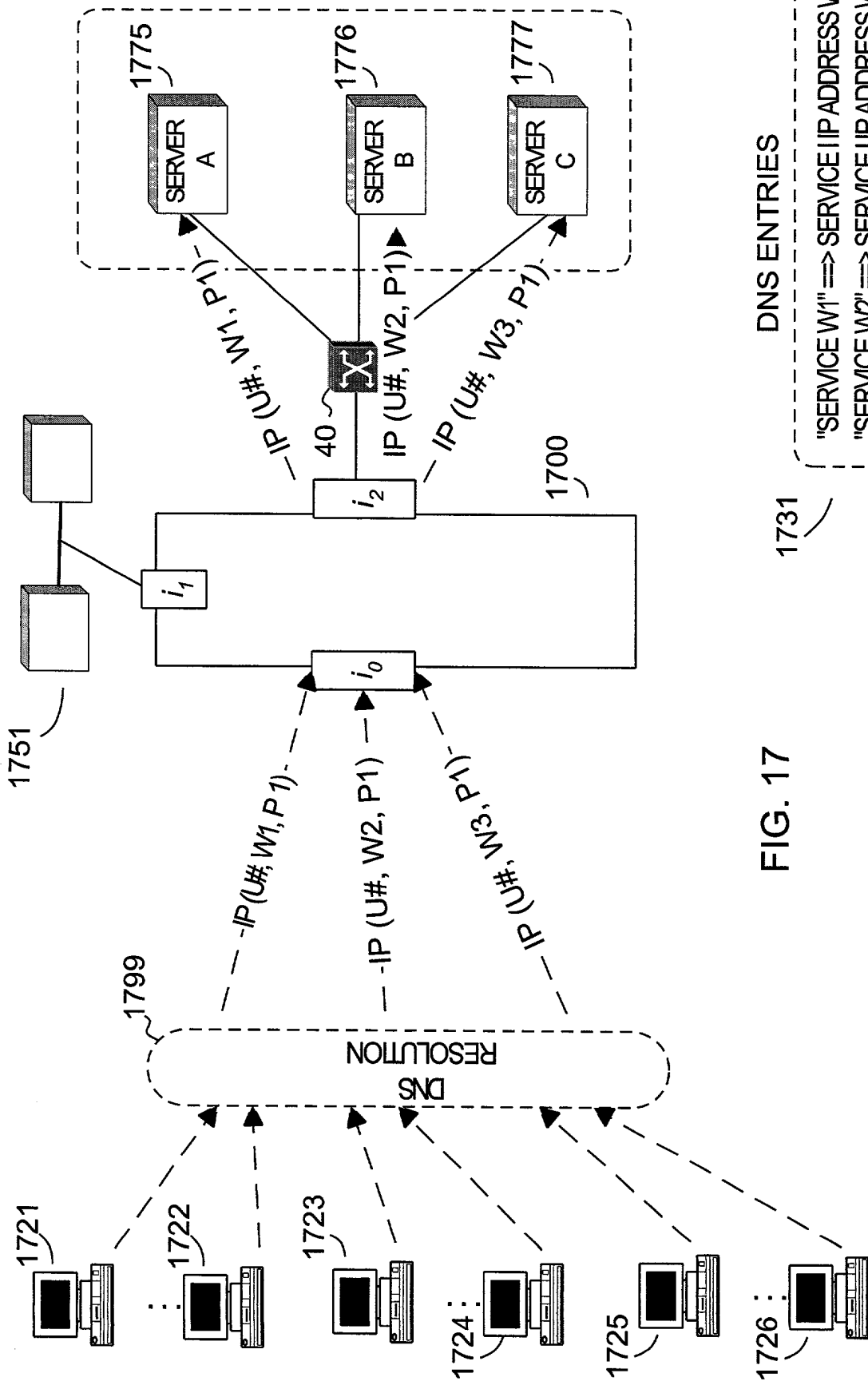


FIG. 17

FIG. 17A

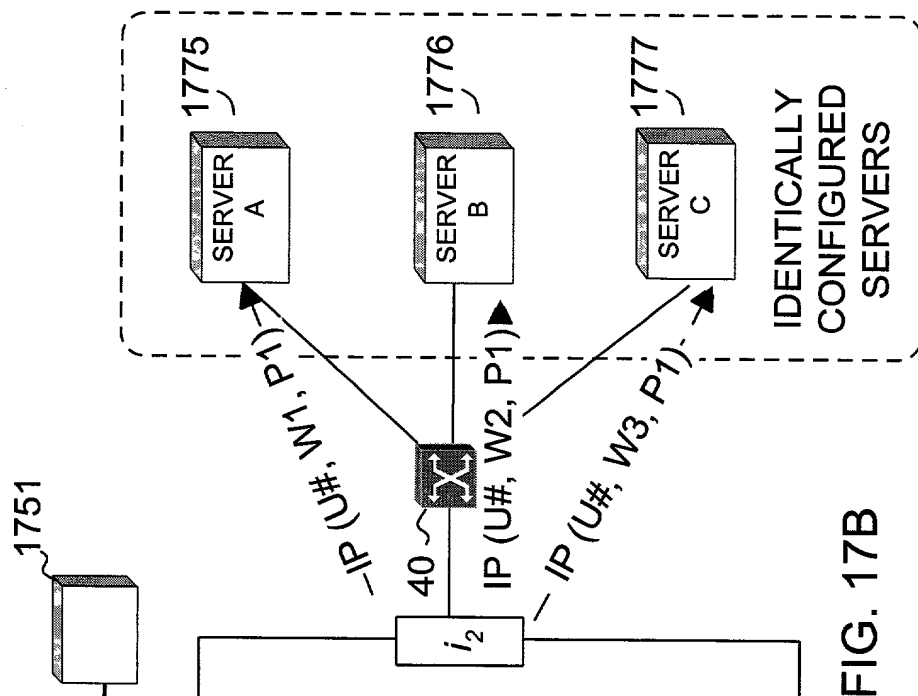


FIG. 17B

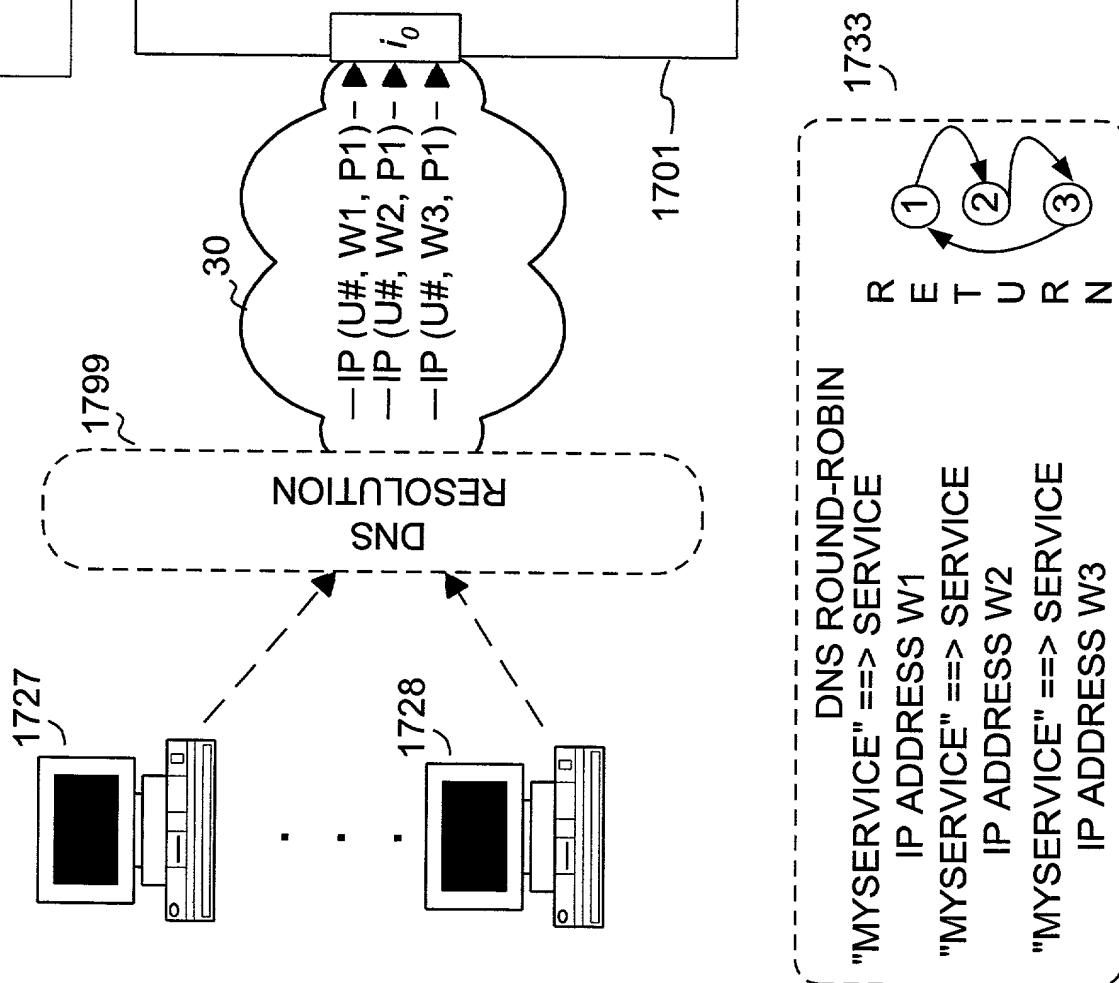


FIG. 17C

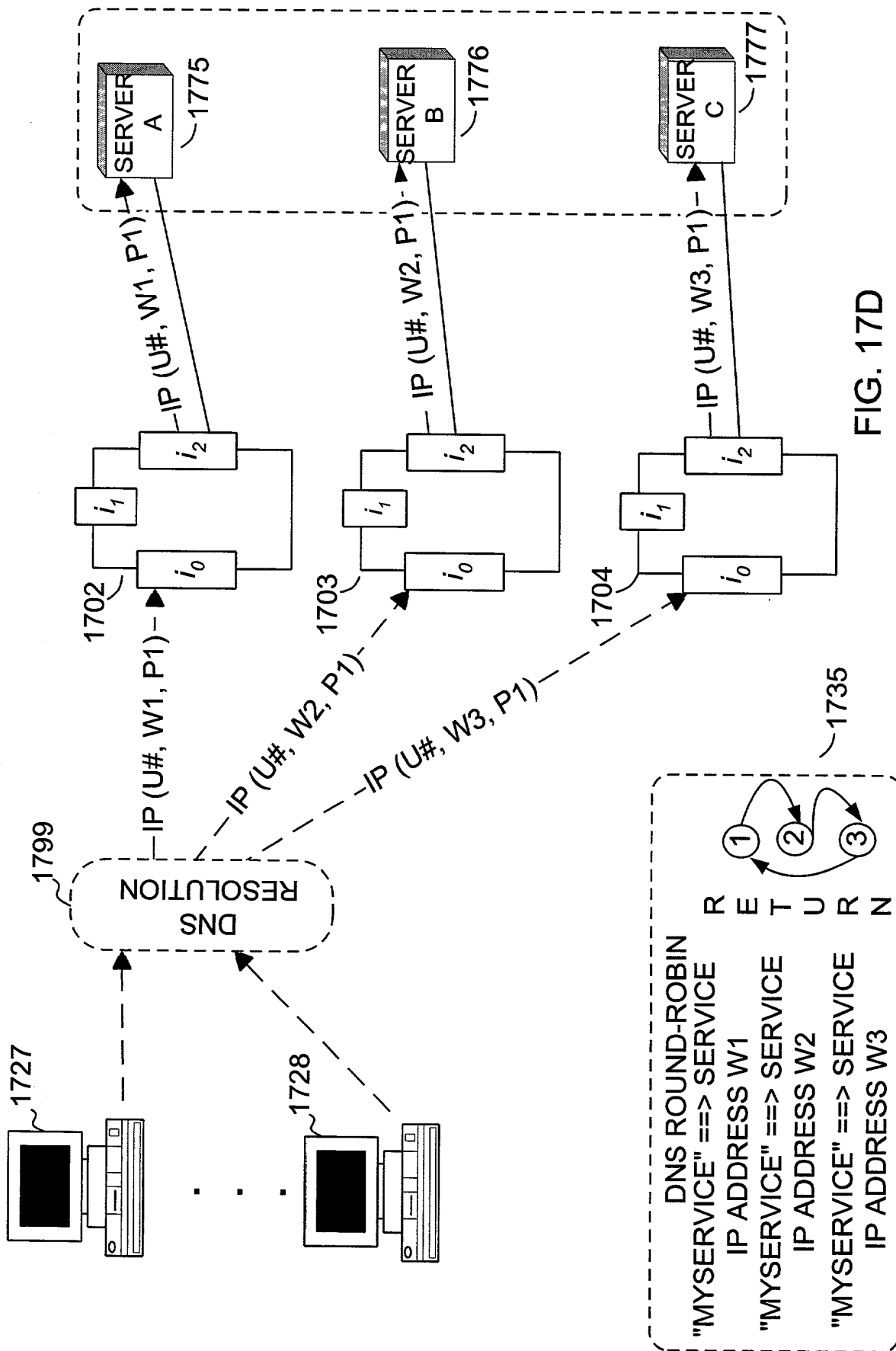


FIG. 17E

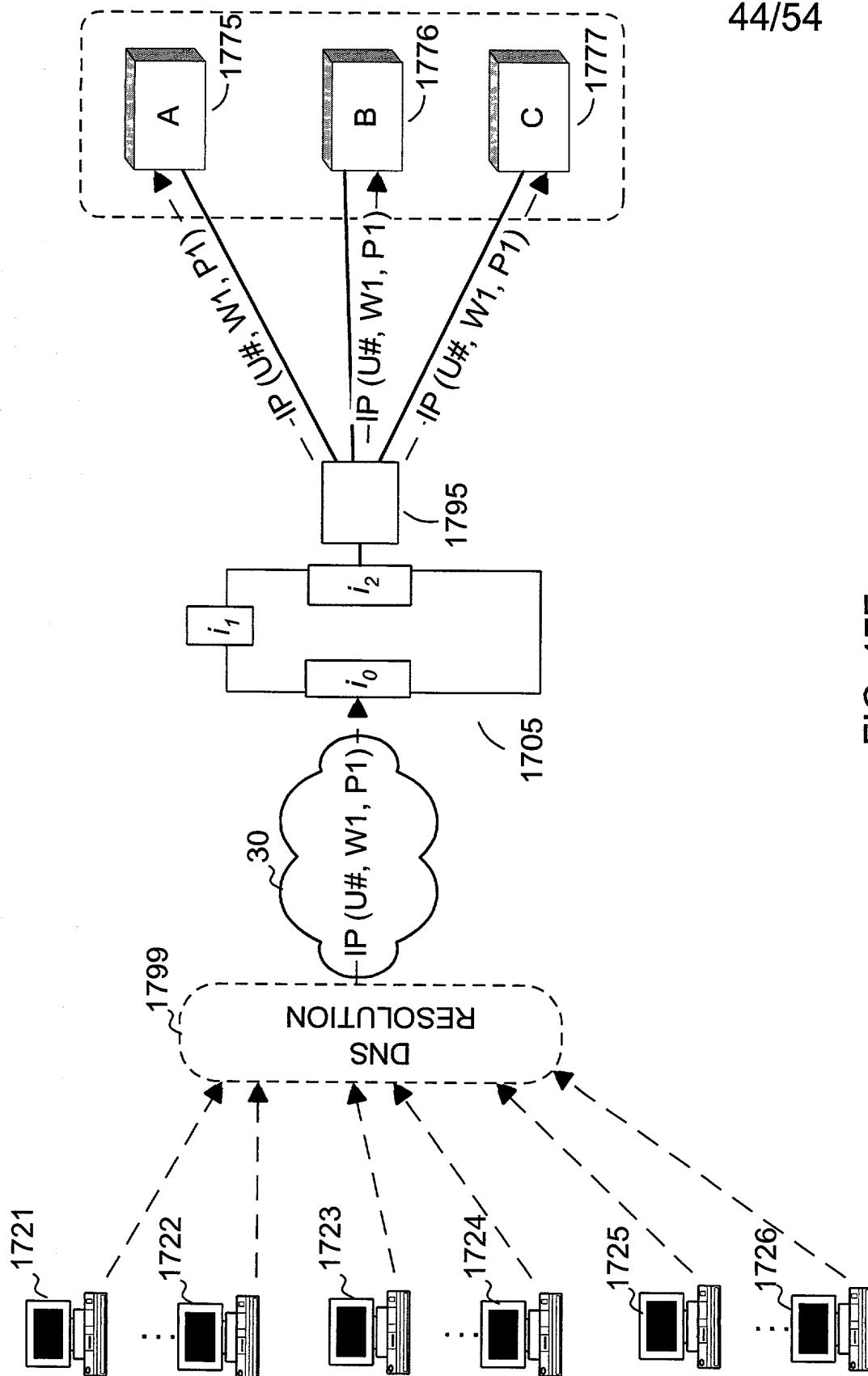


FIG. 17F

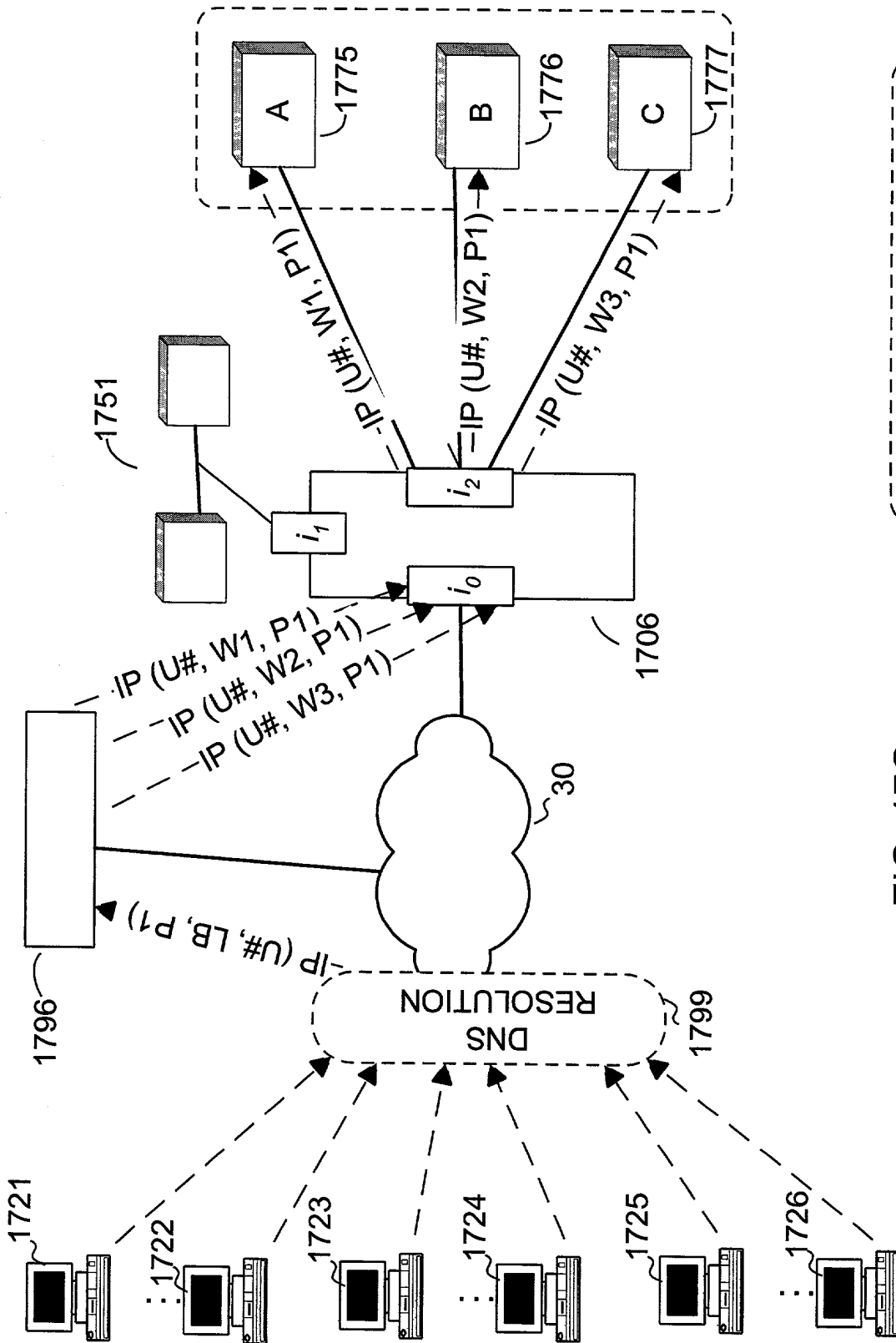


FIG. 17G

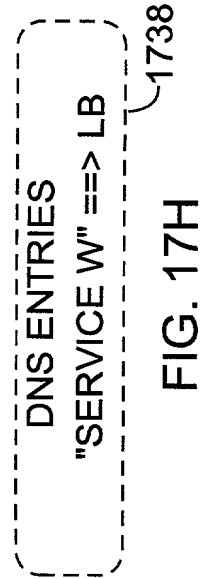


FIG. 17H

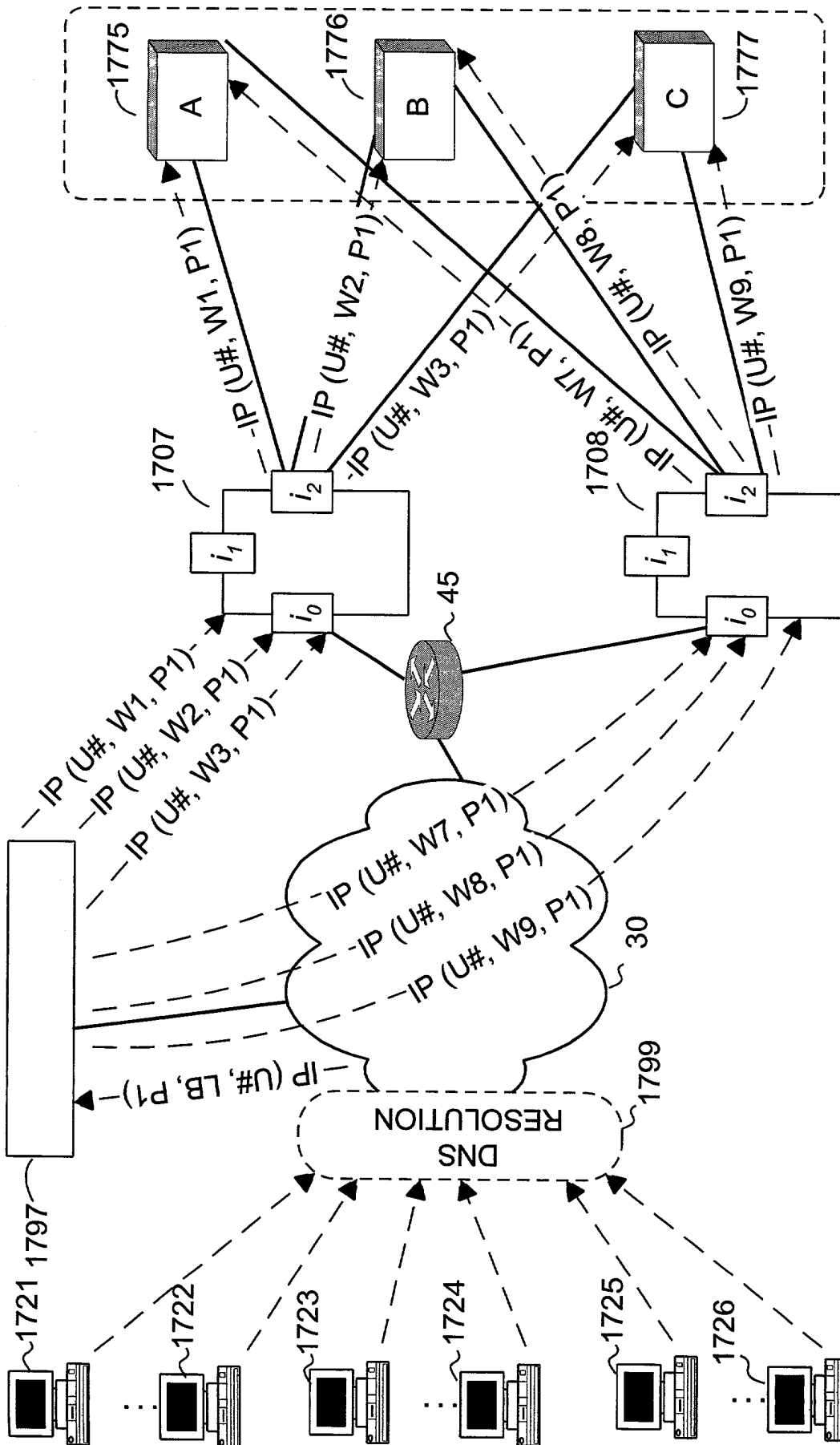


FIG. 17I

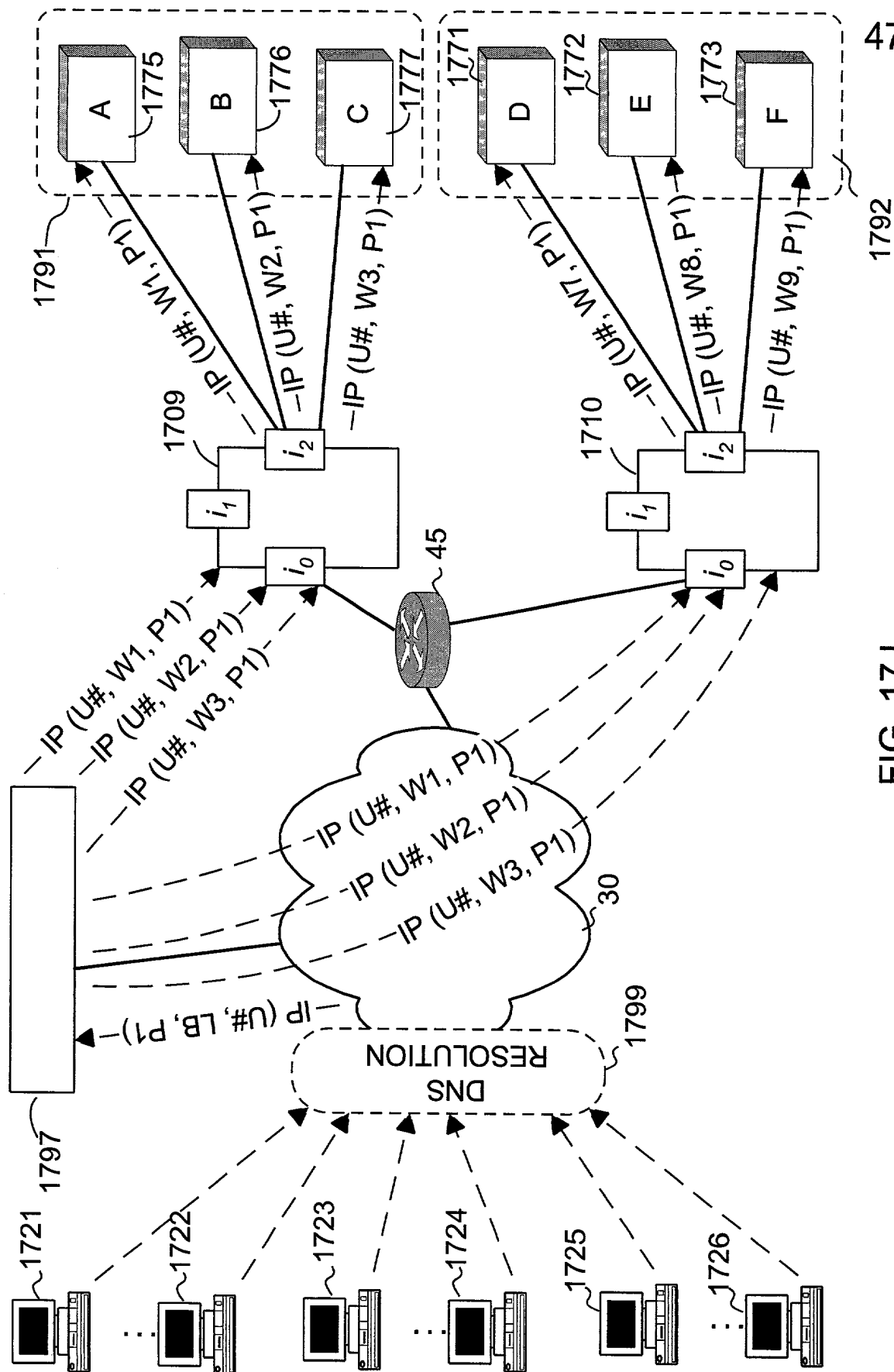


FIG. 17J

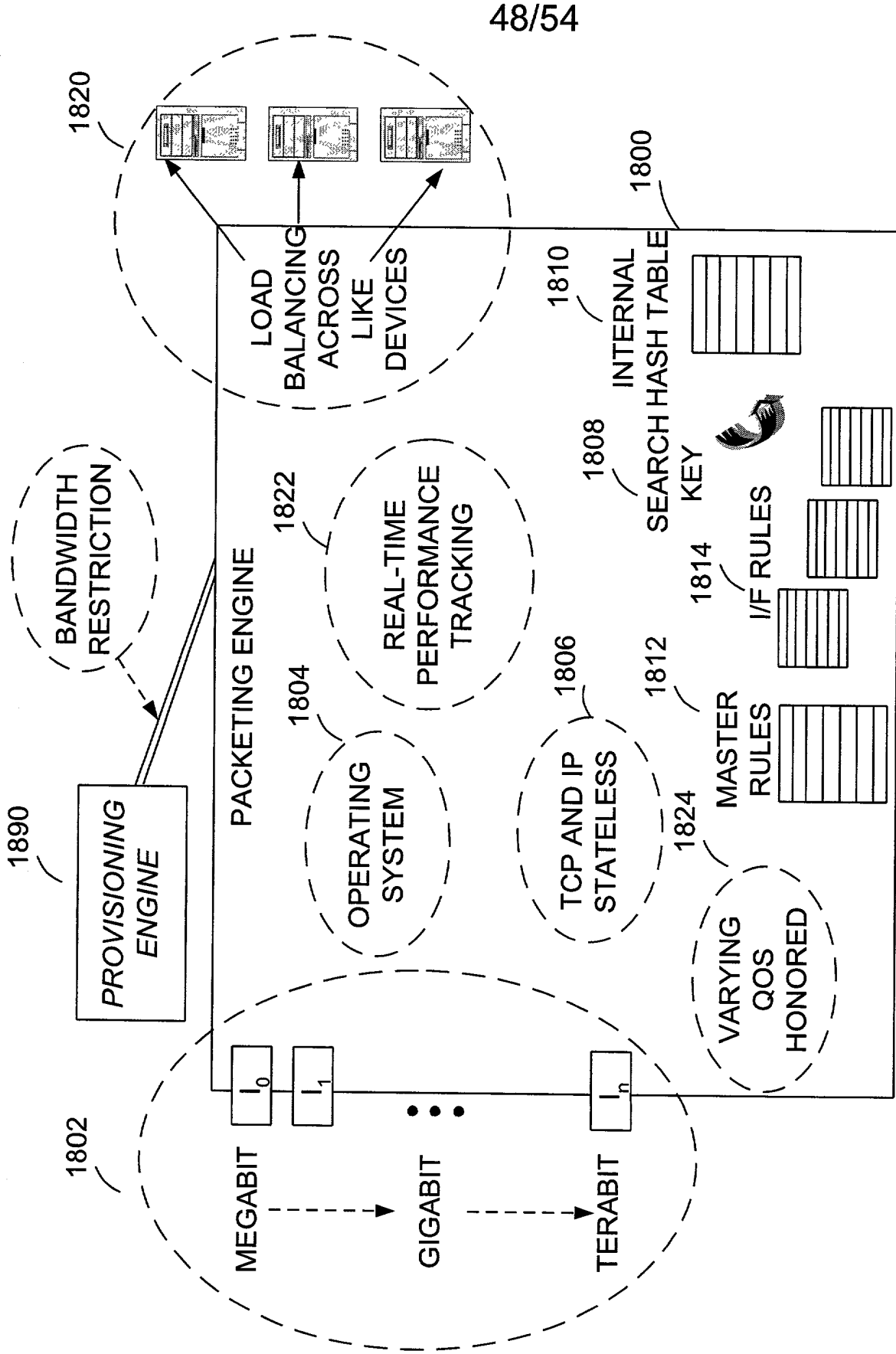
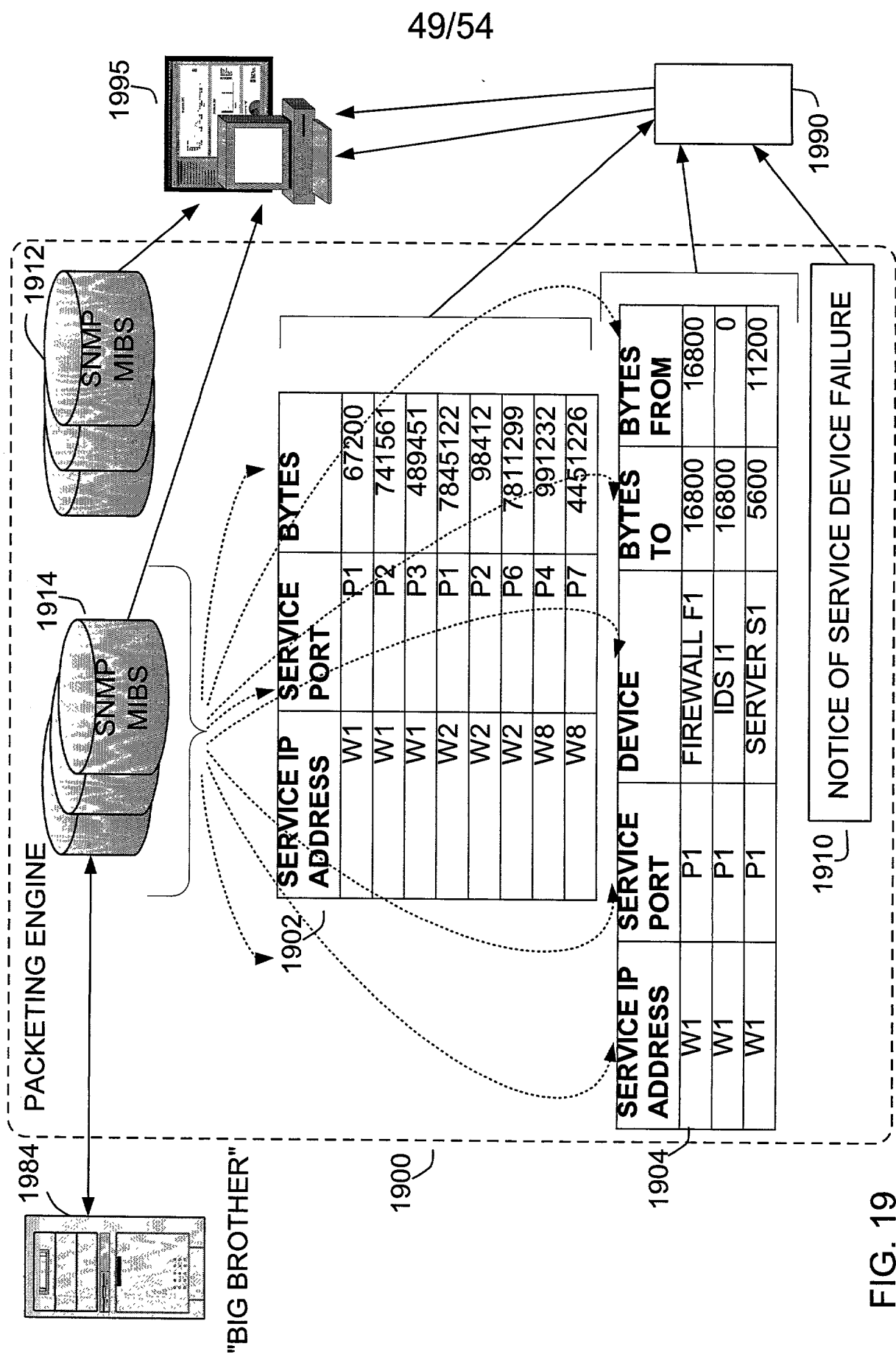


FIG. 18

FIG. 19 is a block diagram of a network monitoring system. The system includes a "BIG BROTHER" component (184) which is connected to a PACKETING ENGINE (194). The PACKETING ENGINE is connected to two SNMP MIBS (1912 and 1914). The SNMP MIBS are connected to a central component (190) which is connected to a server (1990) and a printer (1995). The central component (190) also receives input from a NOTICE OF SERVICE DEVICE FAILURE (1910). The central component (190) contains two tables: a SERVICE IP ADDRESS table (1902) and a SERVICE IP ADDRESS table (1904). The SERVICE IP ADDRESS table (1902) has columns for SERVICE IP ADDRESS, SERVICE PORT, and BYTES. The SERVICE IP ADDRESS table (1904) has columns for SERVICE IP ADDRESS, SERVICE PORT, DEVICE, BYTES TO, and BYTES FROM.



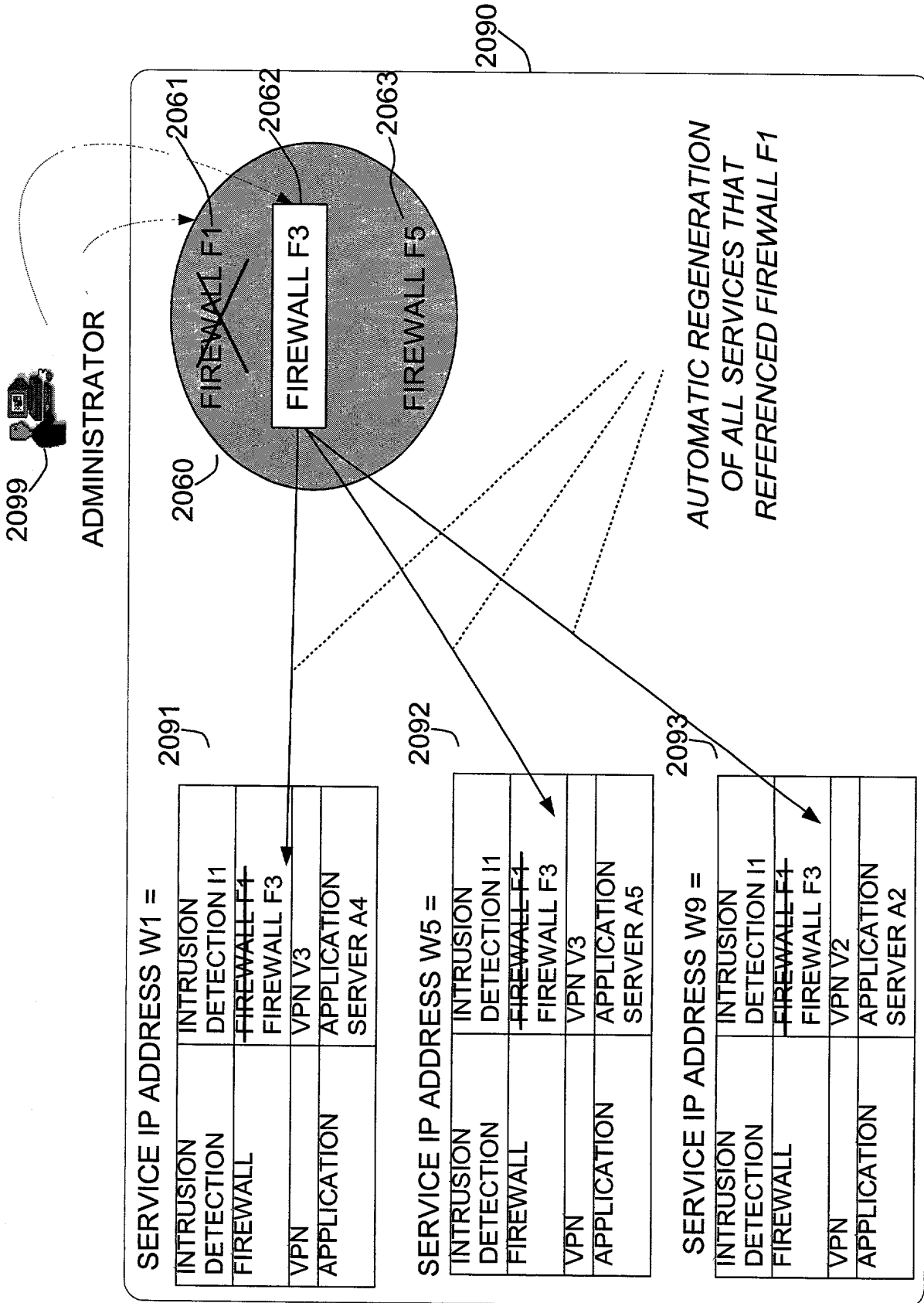


FIG. 20

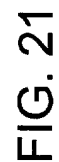


FIG. 21

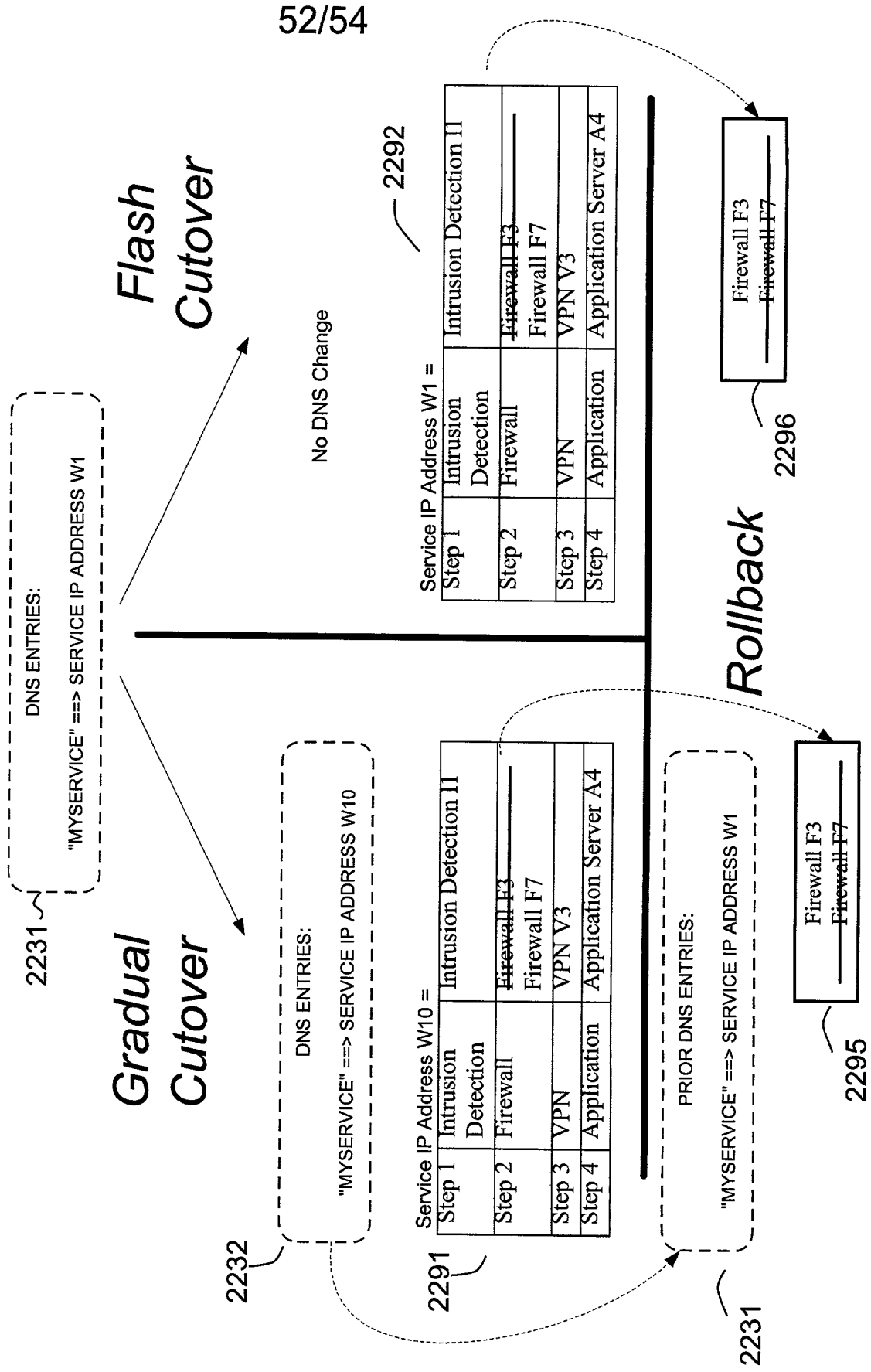
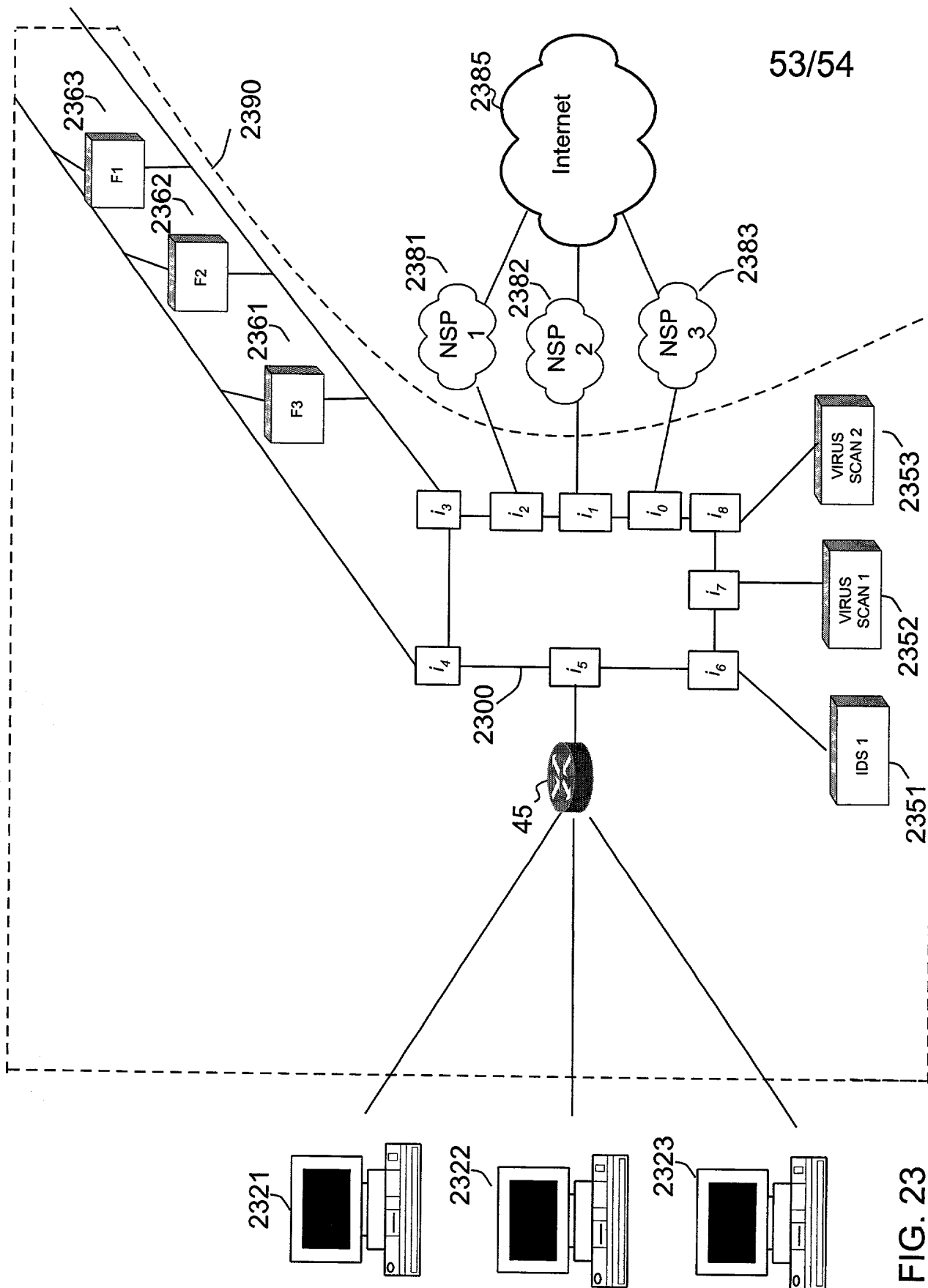


FIG. 22



53/54

FIG. 23

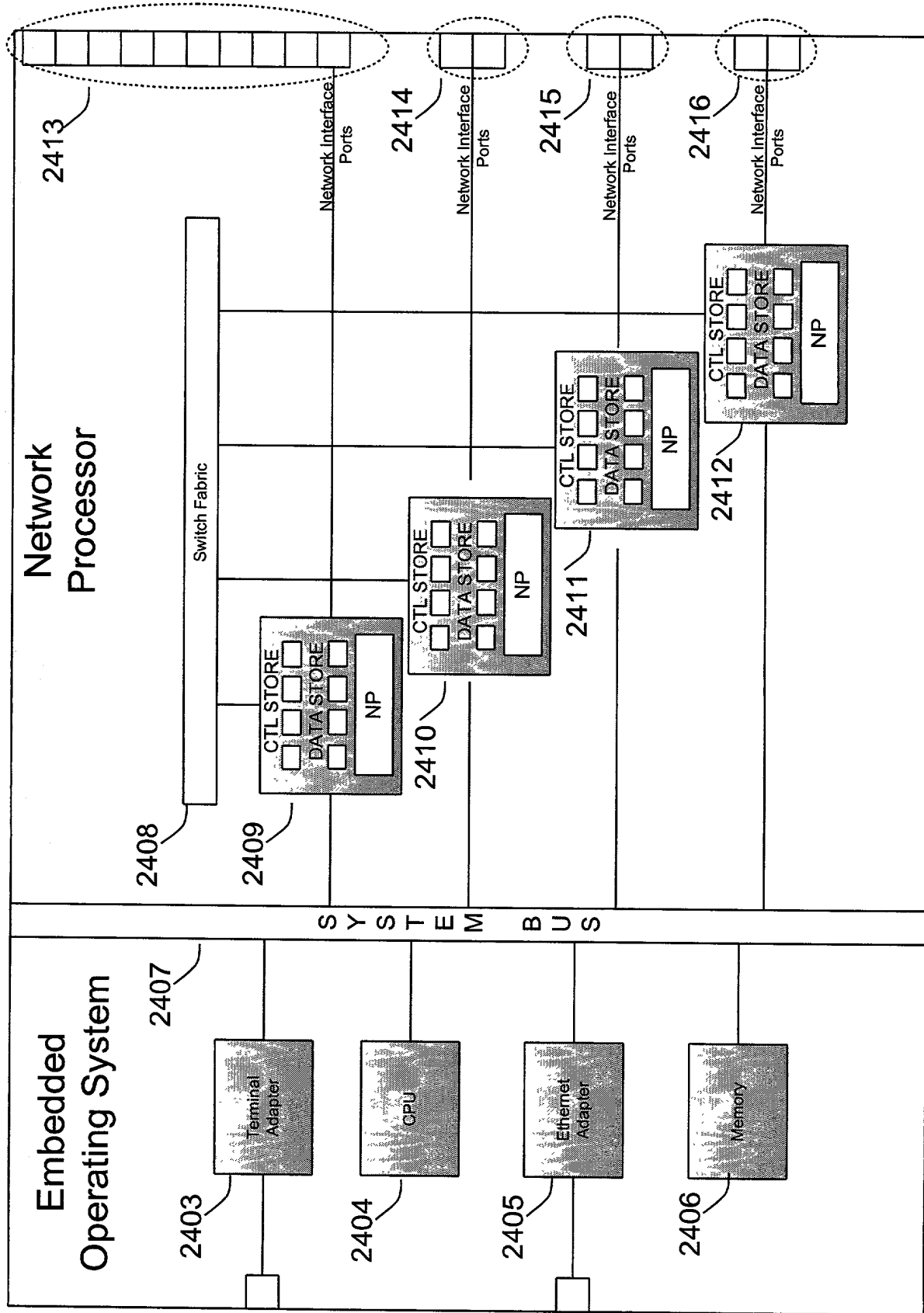


FIG. 24